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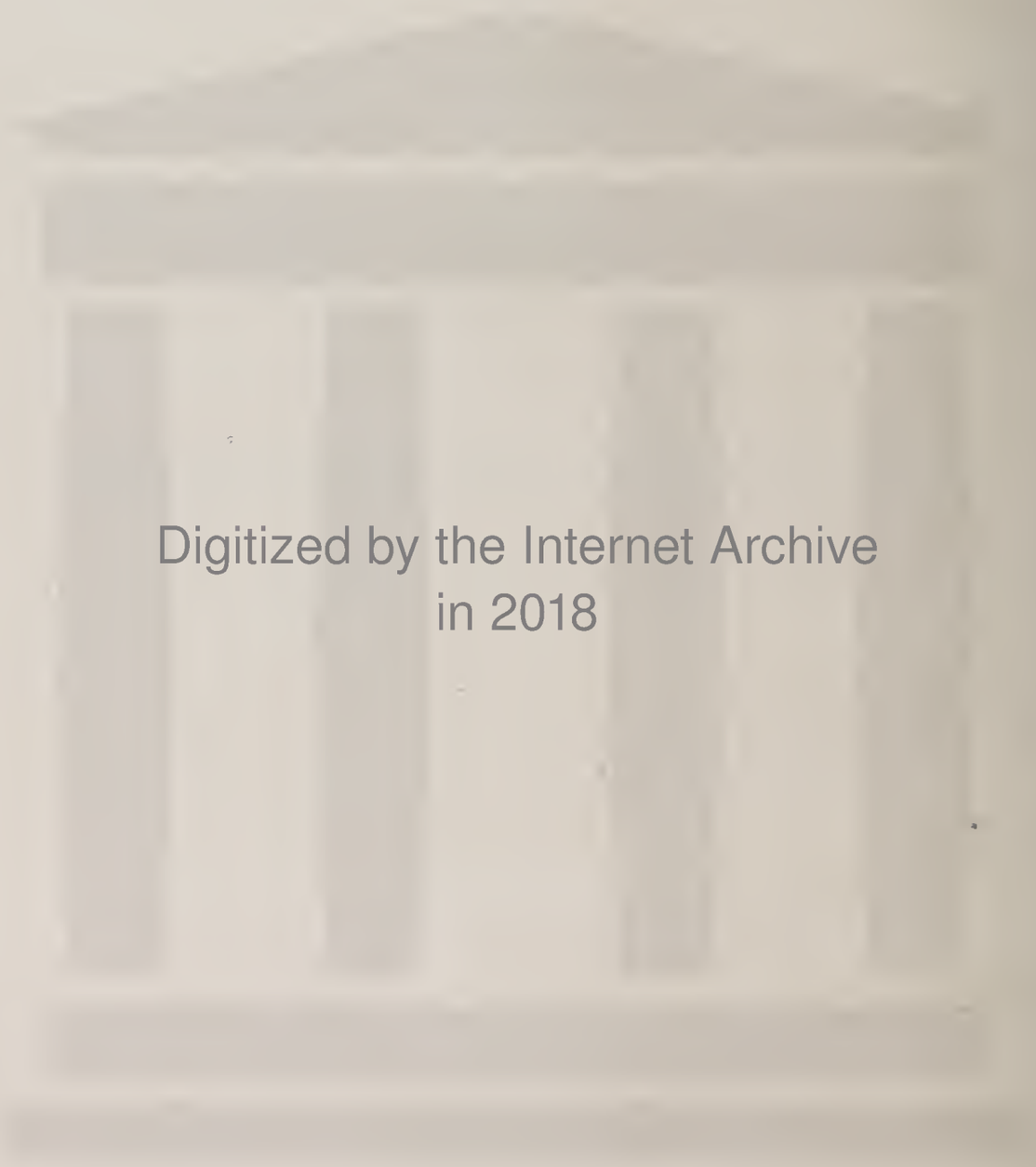
The Life of Charles F. Burgess



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A ROMANCE IN RESEARCH

The Life of Charles F. Burgess

Student—Teacher—Researcher—Industrialist

By

ALEXANDER McQUEEN

with a foreword by
GEORGE W. HEISE
and a technical
appendix by
OLIVER W. STOREY

Pittsburgh · 1951

The Instruments Publishing Company

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PRINTED IN THE UNITED STATES OF AMERICA

FOREWORD

By GEORGE W. HEISE

UNDERGRADUATES of the first decade of the present century at the University of Wisconsin will remember with affection the Chemistry Department, steeped in the academic tradition and dominated by such leaders as Louis Kahlenberg, brilliant iconoclast, in physical chemistry, and Victor Lenher, oracle in inorganic and analytical chemistry. Many, perhaps most of us who hoped to make chemistry our profession, viewed the future largely in terms of teaching and academic research rather than in industrial chemistry. The latter, to be sure, was eventually to absorb its fair share of our number but, in the absence of the system of well-equipped laboratories largely responsible for the present preeminence of chemical industry, immediate entry into that field was usually obtained only through the analytical laboratory—at a stipend of $50 per month.

Those of us fortunate enough, in our contacts with other departments, to make the pilgrimage over the Hill to the old Chemistry Building found a new luminary in the chemical firmament. For here was the domain of Prof. Charles F. Burgess, the man responsible for the course in applied electrochemistry and the organization of the newly installed Department of Chemical Engineering, already well known for his brilliant researches in corrosion, electrolytic iron and a host of allied fields. An inspired teacher, it was he who gave, to some of us at least, our first real insight into the translation of chemical theory and discovery into commercially useful, practical applications.

To me, the keynote of Burgess's career is furnished by his self-dedication to "applied research", as expressed in his frequent allusions to "the inspiration and joy . . . in prosecuting research under conditions in which the worker can watch his idea, started in the laboratory, become an instrument of service to mankind." This, with the belief that research could furnish its own endowment, encouraged him to seek a broader field than that afforded by his University position for the exploitation of his ideas. To relinquish the prestige and security of his professorship for the hazards of a research organization of his own, established with very limited, and partly borrowed funds, implies vision, and devotion to an ideal far beyond motives of material gain. It was this ideal that in-

tegrated his diverse activities, as scientist, teacher, consulting engineer, inventor and industrialist into a unified, successful career.

With the multiplication of his responsibilities his direct contact with laboratory work necessarily diminished, yet his interest in the research ideal continued unabated. And in his later years, after he had relinquished direct control of the Burgess organization, he resumed investigation in his own private laboratory and attempted to promote the development of future research workers through the medium of handicraft shops.

Significant, and entirely logical, is the fact that the success—as well as the existence—of the associated commercial enterprises which made up the Burgess "empire" was founded on the development, by research methods, of new and profitable fields of production, rather than on invasion of existing industries. Even in his favorite venture, the dry cell, already well established when he entered the field, the Burgess eminence was based not on destructive competition, but rather on improvement of battery quality (particularly as regards the smaller, e.g. the flashlight size) and extension of its uses, with resulting increase in production and benefit to the industry as a whole.

Indicative of the times is the recent demise of the Burgess Laboratories, potentially the greatest of the Burgess enterprises, which found conditions incompatible with its continued existence. It would indeed be regrettable if a trend, such as that already noted in other countries toward "an over-organized bureaucracy of which we see so much today . . . and state-aided research (which) has assumed almost menacing proportions"*, should ever create in the U.S.A. an environment permanently unfavorable to the establishment or continuance of similar organizations. Yet the fact that it might be difficult, under present politico-economic conditions, to carve out a similar career, can in no way detract from the magnitude of Burgess's achievement.

In the course of his technical career, Dr. Burgess received high honors:—medals, scientific awards, and academic degrees. His contributions to scientific thought, his development of profitable lines of research and his organization of new industrial ventures give him a prominent place among the Nation's great. His memory will be cherished by the students whose careers he influenced, by the associates who aided him in his various enterprises, and by his fellow workers in his favorite field of research, electrochemistry. His influence will be felt even by future generations, in the ranks of labor as well as in scientific and technological activity, who will benefit from his works.

*Lampitt, L. H., Chem. and Ind. No. 29, p. 454 (July 17, 1948).

AUTHOR'S PREFACE

MY only preface is a word of thanks. Thanks are due first to those who granted me the privilege of gathering the material and writing the book, and thereby brought me closer to Charles F. Burgess.

Thanks are due to Mr. Heise for his illuminating foreword, a clear and orderly statement of Dr. Burgess's relation to the world he lived in.

Thanks must go to the many friends and associates of Dr. Burgess who gave generously of their time and helped with oral or written records of their memories. There were hundreds of them, too many to receive in this brief space the individual mention they deserve.

Special recognition is due Mr. O. W. Storey, whose aid was called upon throughout the work. As student, colleague, business associate and friend of Dr. Burgess through almost forty years, Mr. Storey was ideally qualified to advise. In the scientific and technical chapters his help, given with patience and consideration, was indispensable. The comprehensive appendix which he wrote will be especially appreciated by technical readers.

Now, at long last, the "Burgess Book" is done. I hope that when you read it you will share in the pleasure I felt when I was writing it.

A. M.

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1.

Boyhood

ANNA HECKMAN had a lot to think about as she stood on the deck of the sailing vessel, bound southward from a little harbor in Nova Scotia and bearing her ever closer to the man she loved. That man, Fred Burgess, had been born within twenty miles of Evangeline's Grand Pre, but Anna was no Evangeline. She knew that her betrothed, who had preceded her to the United States, was safe and well; she was confident that her journey would have a happy ending. The journey's end was indeed to be happy, and many years of happiness were to follow. But the young woman wasted no time in prophesying; all her waking hours were filled with planning.

As the ship sailed on, Anna smiled and looked grave by turns, for she was making a mental list of her qualifications for marriage. Health, good—nothing to worry about on that score. Schooling, meager—but life could be her school. Wealth, none to speak of—was that a problem for Fred to solve? Anna decided that it was not. She came of pioneer stock; to her, marriage was a partnership, not only of rights but of responsibilities. She would be a real partner, bearing her share of every burden, even the burden of finances. Her marriage plans would have to wait awhile; she would go to work and earn a dowry. Before sailing she had said to herself, "I'll go to Frederick, but I'll not go to him empty-handed."

So, as was the custom with many Nova Scotia girls, Anna Heckman went to work in a shoe factory at Lynn, Massachusetts, at the salary, fair in 1869, of five dollars a week. Half of this served for living expenses; she used to tell her children that $2:50 enabled her to live "in luxury"; the other half went to the nest-egg to help in setting up housekeeping.

Fred Burgess accepted the arrangement without too much grumbling, because, as a native Nova Scotian, he loved independence, even in the woman who was to be his wife. Nova Scotians were like that; Frenchmen independent of Britain; British loyalists independent of America; freedom-loving Germans settled in Lunenberg as early as 1753; and among them all, even as late as 1869, a strong minority still resisting union with Canada.

By the winter of 1871, Fred in Wisconsin, and Anna, still working in Massachusetts, decided that their native self-reliance was a virtue that

they need not lose by getting married. So one cold day, after several weeks of correspondence, Fred appeared in Lynn, and there, on February 27th, 1872, they became man and wife. Their wedding journey was a trip to Oshkosh, the place that was to be their permanent home. There, on an income that for several years stayed below ten dollars a week, they set up housekeeping; and there, on Sunday, January 5, 1873, was born their first child, Charles Frederick Burgess.

It was a busy day in the little house. The coming of that first little boy was an exciting event, and friends and neighbors came to help, and talk. Some of them, no doubt, quoted old verses about the blessings sure to attend a child "born on the Sabbath day", and maybe some local sage remarked that the baby shared his birth-date with Stephen Decatur of U. S. Navy fame, and Zebulon Pike, discoverer of Pike's Peak. But young Charles Frederick knew nothing of all this, and cared less. It would be many years before he could muse on the fact that he was born in the same year as barbed wire, the trade-mark "Celluloid", St. Nicholas Magazine, the U. S. penny postal card, and Lee de Forest. By the time he was five, however, the boy had learned a great deal about his parents; and through them about a wonderful new age that the world was entering—an era to be known as the age of electricity.

A household word in those early days was the name of Thomas Alva Edison, who had already invented an electrical vote recorder, a stock ticker, an automatic telegraph system, a microphone and a phonograph. Edison, "the wizard of Menlo Park", was a legendary hero to Charlie Burgess, who never dreamed that some day they would be neighbors, and indeed, fellow scientists. And when, in the winter of 1878, his parents talked about Edison's success in adapting electric current for household use—and New York gas stocks fell 20% when the news was published—the little boy had no idea that some day he, too, would occupy a respected place in electricity's hall of fame.

But in those golden days he was still a child, and as a child he stored up in his mind a rich treasury of impressions, a treasury on which he was to draw throughout his life for memories of loving parents and a home that was happy and wholesome and thrifty. Thrifty it had to be, for, as Charlie liked to tell in later life, the Burgess income was very small. Fred Burgess worked at various times as stone-mason, carpenter, and grocery clerk, and when Charlie was not more than six years old, he learned from a dinner-table conversation that the family budget had to be kept within $1.50 a day. Mrs. Burgess wondered how some neighbors could bring up six boys on $1.00 a day, "when it costs us about that much for only two boys." The second boy was George Heckman Burgess, born in 1874. For rent of the six-room house in which they lived, they paid six dollars a month. All the clothes worn by Charlie and George until their early teens were made by their mother.

Besides being an expert needlewoman, Anna was an excellent cook. Charlie never tired of telling how his mother "could almost make codfish talk." Throughout his life he chanted the praises of her codfish balls, her codfish and pork scraps, and especially her creamed codfish. He

Birthplace of C. F. Burgess, Division Street, Oshkosh, Wisconsin

Winnebago County Court House and Sheriff's Residence, Court and Otter Streets, Oshkosh, Wisconsin

delighted to tell how "she soaked it, shredded it, baked it, and served it with cream and butter—it was a wonderful dish!"

In 1878, Fred Burgess was appointed deputy county clerk and jailor of Winnebago County, serving in that capacity till 1881. In 1880, when Charles was seven, and George was six, they started in school together, and for many years, as a neighbor put it, were "always collective, never separate." Alike in size, though not in looks, they were often called "the Burgess twins," and George sometimes answered to the name of Charles. Together the boys went to the First Baptist Temple, attending its services, its Sunday School, its prayer meetings. Together or separately they earned money by performing various neighborhood tasks, especially by carrying newspapers. Lewis Brown, a small boy employed by Charlie to deliver papers "on one side of the street," was paid one penny per evening. Perhaps he saved his pennies for an education; anyhow, in later years, as special student Lewis Raymond Brown, he received his B.S. in Electrical Engineering at Wisconsin. That was in 1903; later still he became prominently identified with the General Electric Company. Another boy in the group—Charlie called it a gang—was Duncan Keith, who in those days preferred to be known as Harry. Duncan was destined to play an important role in the Burgess drama; but Charlie had no means of knowing that. The future, as he saw it, was a rosy pathway of discovery, along which he meant to travel far, learning how to make things and how to make them work.

This boy, who was to become a scientist, owed much to the example and inspiration of his mother. Anna Heckman Burgess never ceased to regret her lack of formal education; but by reading and listening she built up an immense store of useful information, and by a sincere interest in people, friend and stranger alike, she made her home a place of gracious living. She proved to all who knew her that hard work is no bar to real culture.

Hard work there was aplenty, much of it of a kind now long forgotten, and often due to the need for getting along with a minimum of money. Charlie and his brother sometimes went out to the marshlands to cut and carry home the spikes of the cat-tail, and their mother showed them how these "condensed packages of soft, downy material" could be used for stuffing pillows. The cat-tails at the end of their long stems could also be soaked in kerosene, lighted, and carried in torchlight parades. Years later, Charles was to recall with profit the remarkable properties of Typha spikes, both as to resiliency and oil-absorption.

American housewives, in the 40's of the 20th Century, saved kitchen fats and turned them in at stated times and places "to aid the war effort," often with no conception of what was meant. Anna Burgess in her day saved kitchen fats and grease, but she knew what to do with them; she combined them with lye of her own manufacture in the making of soft soap. She was always resourceful. Later on, in another house, when things went wrong with the plumbing, Anna didn't phone for a plumber; neither she nor the plumber had a telephone; besides, the family budget did not allow for repair bills. She didn't even wait for her husband to

come home. She up and fixed the leaky pipes herself; and it was from her that little Charles learned about the hydraulic phenomenon known as water-hammer. Though never claiming the title, she was her son's first science professor.

Sometimes Anna would take the little boys to see her parents in Lunenberg, Nova Scotia. Those were notable occasions. Grandfather and Grandmother Heckman had no need to plan special entertainment for their young kinsmen; everyday life in Lunenberg was as interesting as a circus, and sometimes as exciting. The boys spent hours watching their grandfather at his bench, as he turned out stout boots for the village people. For Isaac Heckman, besides being captain of a fishing vessel, was a custom boot-maker; his fine high boots were famed for miles around; also some special models that he made for the ladies. No wonder that in her shoe-factory days Anna had held a supervisory post; she had doubtless learned from her father how to judge the marks of good workmanship. One of Charlie's most vivid memories was of the time when Isaac Heckman made boots for his two grandsons. Those boots, he once said, "with their red leather tops, gave us greater thrills than boys now get when given their first automobile."

Another thrilling experience was to go out with Grandfather in a whale-boat to fish for mackerel, and one such memory was impressed on Charlie's mind in a manner not only exciting but painful. "It was well out in the ocean," he recalled, "that we began operation, which was to throw a loaded hook out as far as possible into the water, which had first been given a patch of oil-slick by throwing overboard chopped-up decayed fish. As Grandfather whirled the baited hook preparatory to casting, I suddenly jumped up with excitement, and intercepted the hook, which planted itself so firmly in the top of my head that Grandfather could not remove it. He said, 'Never mind, Grandma will take it out when we get home.' And so it was; she went to work, got a razor, boiled it in the steam-kettle, and with a deft stroke removed the hook." Grandma's surgery and after-treatment were so good that the wound healed without leaving a scar. Grandma Heckman possessed a skill in the healing arts which brought her fame throughout the countryside. Twice, when people's wrists were broken, she had set them; when someone's hand was cut deeply with a scythe, she sewed it. When a man had his finger almost cut off "just hanging," she fixed it, and the finger was not lost. She obtained cod-liver oil from the fishermen, and made emulsion for the entire neighborhood. Two infant boys were sick unto death with scarlet fever; two doctors said nothing could be done for them. Grandma, by some miracle of herbs and steam around the crib, was credited with saving the two young lives; one of the doctors said to her, "You are a born physician." A generous share of this knowledge and ability she was able to pass on to her children, perhaps most notably to her second oldest daughter Anna, the wife of Fred Burgess.

So, from his earliest days, Charlie lived in an atmosphere of accomplishment, of difficulties overcome, of problems met and solved. Even as a boy he began to assume that if a thing has to be done, it *can* be done; furthermore, that if a certain effect is desired, it must depend upon a certain cause. But it would be years before he bothered

Burgess home at 333 Jackson Street, Oshkosh, Wisconsin

Burgess Family Group—about 1890

George H. Mrs. F. Burgess Charles F. Frederick Burgess
Kenneth F.

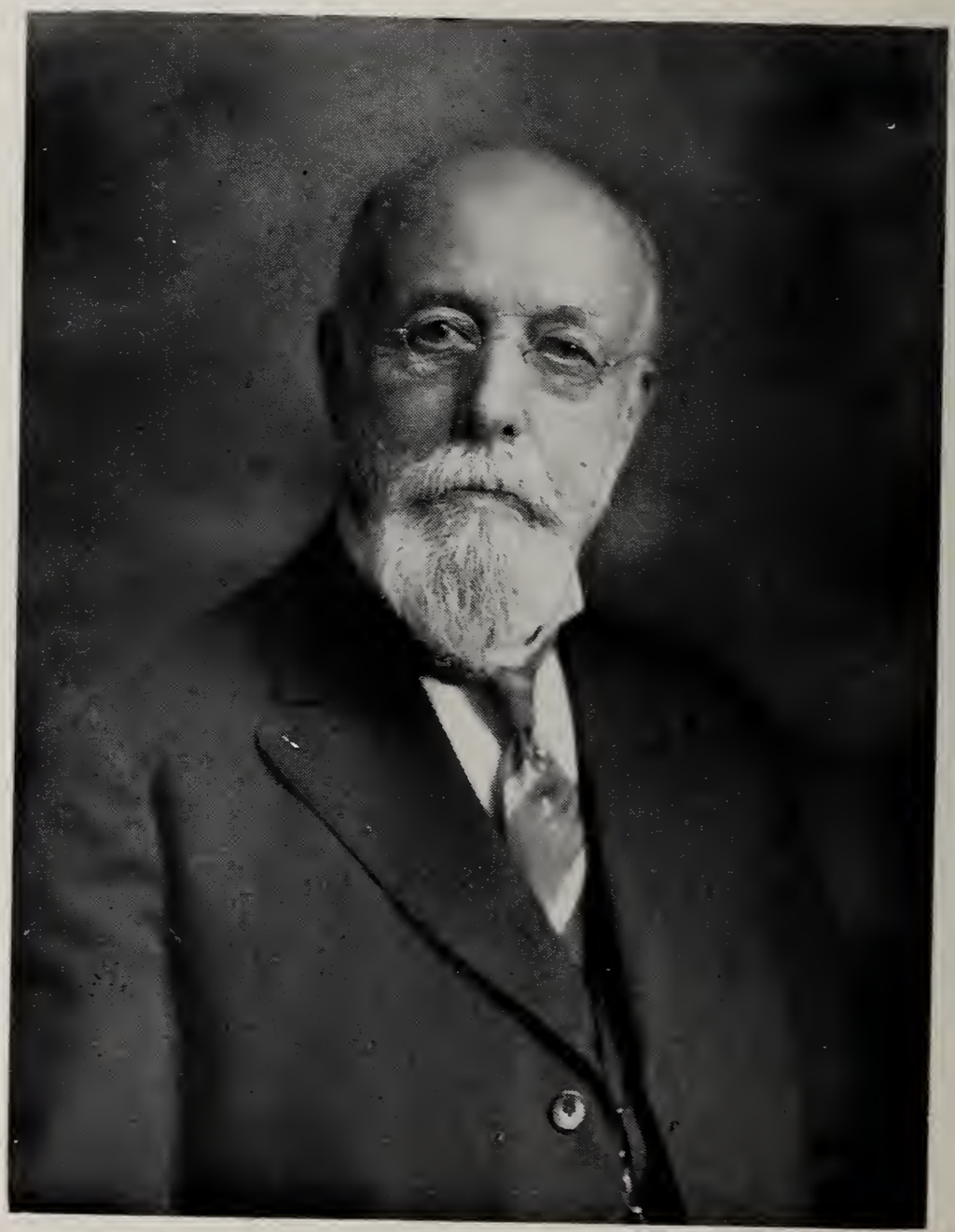
his head with deep reasonings about cause and effect; he was still a boy, and lived the life of a boy, sailing, fishing, swimming, skating, carrying papers—and going to school. In school, he sometimes got into mischief, but, as his brother George said later, "not too much"; George was probably in it too. Mischief or not, the boys managed to carry home pretty good marks, and in earning those marks there was a trace of rivalry. The rivalry gave Fred Burgess an idea; he seldom asked his boys how they stood; but if he found that one was far ahead of the other, it called for an explanation: Why had the other lagged so far behind?

One well-remembered day the boys were taken to a county fair, where they "had their bumps felt" by a wandering phrenologist. The "professor's" report on George's mental state was favorable; but for Charlie all he could say was "Better make a paper-hanger of *this* boy; don't send him to college—it would be a waste of time." In the family circle the retelling of this story never failed to bring a laugh, but no one took it seriously; Mother least of all; no son of hers would ever lack for learning. As eagerly as Charlie himself, she began to look forward to his college days; and to encourage him to prepare for those days, she bought him what he later described as "a book of elementary science."

The purchase of that book, and the sending of the boys to dancing school, were symptoms of growth in the family income. This growth was fairly steady through the years, and was aided by Fred Burgess's success in holding official positions. On January 1st, 1885, he became Sheriff of Winnebago County, holding this post till the end of 1886, and again for the years 1889-1890. In 1885 the boys had the interesting experience of living in the sheriff's quarters adjacent to the county jail. Charlie sometimes colorfully described it as "living in jail." Occasionally they had long talks with some of the jail's inmates. This added to a stock of picturesque memories, and earned the envy of their classmates who had to be content with ordinary homes.

The thrifty Anna continued to serve as custom tailor for her two sons. "By paid for cloth, etc., children's clothes, $8.50," appears in an old account book under the date of February 16, 1886. Every penny saved in 1886 was important; for in that year Fred Burgess was building the "new house" at 333 Jackson Steet, Oshkosh, where he and his wife were to pass the remainder of their lives and some of their happiest years. In this house, on October 16, 1887, was born their third son, Kenneth Farwell.

Charlie loved to read the *Youth's Companion,* which he, like most other boys called "Yuse" *Companion.* He read every story, every article, every advertisement. Would *he* ever be able to advertise something and make money doing it? Or would he make money in some more romantic way, say as a pearl-fisher? Such thoughts were not as queer as they might seem; Wisconsin in the eighteen-eighties was going through a pearl-fishing craze, and pearl-producing clams were found in the Manitowoc River, not twenty miles from the Burgess home. But the lure of the pearl meant little to a boy whose mind was tuned to electrical impulses; and such impulses, reaching him through the press, were



Frederick Burgess

Mrs. Frederick Burgess

frequent and fascinating. In 1889, on the 5th of November, President Harrison in Washington touched a telegraphic key and set in motion the wheels of an exposition in Montgomery, Alabama. Such feats as this, duly recorded in the *Oshkosh Northwestern,* roused new ambitions in Charlie's mind, and caused him, while still at school, to take an interest in electric batteries. That interest had been strengthened when one of the fire stations in Oshkosh installed an electric alarm system. Charlie was impressed by the fact that a big gong was made to ring through the agency of a relatively small battery. Such a battery was simple and inexpensive; it was something that a boy could handle and use, and even make; and it could be a means of launching new experiments and making new discoveries.

So Charlie Burgess was all set to go. But where? The answer was fairly obvious. He and George had made up their minds that they would go to the University of Wisconsin. George wanted to be a civil engineer and Charlie decided to study electrical engineering. Charlie's decision was made after a talk with Henry A. Allen, whose people lived in Oshkosh, "back of the Burgess house." Allen, six years older than Charlie, had graduated from the U.S. Naval Academy at Annapolis; in 1891 he was with the Western Electric Company in Chicago. He knew of plans being made at Wisconsin to establish a course in electrical engineering, and strongly advised Charlie to register for that course. Years later Charlie wrote him and said "My interest in electrical engineering was due largely to what you told me at that time." In 1947, with a brilliant engineering and military career behind him, Colonel Henry A. Allen was living in Chicago.

Charlie graduated from high school, carried his last newspaper route, gave up his post as treasurer of the Sunday School, and hastened to Madison to enroll in the new course; and though he did not then foresee it, he was to remain with the University as student and teacher for more than twenty-one years.

A new phase in his career was opening, scholastic in environment, but by no means scholastic in all its implications; for Charlie Burgess had some fixed ideas, and those ideas, which colored all his studies and all his teaching, were to move him, slowly but surely, out of the world of learning into the world of trade.

2.

Undergraduate at Wisconsin 1891-1895

"WELL, here I am, and what's it going to be like, and how much am I going to learn, and how successful will I be, and how soon?" Such, we may suppose, were the thoughts of Charles Frederick Burgess, as he and his brother George prepared to adjust themselves to the routine of college life in Madison. To Charlie the University seemed complex and a bit awesome, with himself reduced to a mere entry on the registrar's list: "Burgess, C. F., age 18 years, freshman in Electrical Engineering, deficient in German." It was all so impersonal.

But the ice was soon broken, and within a few weeks Father and Mother Burgess in Oshkosh began to get letters describing new happenings and new friends. Charlie wrote about a number of his classmates; but it soon became clear that his principal friend and hero was his class adviser, later his teacher, Dugald C. Jackson, the man in charge of the new Department of Electrical Engineering. Professor Jackson was only eight years older than his admiring pupil, but the eight years stood for definite progress and achievement. After graduating from Penn State and taking special studies at Cornell, young Jackson had organized a company which built a number of electric lighting and electric railway power plants. He had later held two important chief-engineer posts, one of them with the Edison General Electric Company. His experience and success in the commercial field, based on a happy combination of "know-how" and willingness to learn, made him an ideal man for the Wisconsin post; and when he stressed the importance of not only learning, but of making practical use of what has been learned, his words made a deep impression on many minds; perhaps in a special and lasting way on the mind of Charles F. Burgess.

By the middle of October, the people at home knew that Charlie and George were brothers in a new sense, by virtue of their membership in Beta Theta Pi. The Alpha Pi Chapter of this fraternity had been established at Wisconsin in 1873, year of Charlie's birth. Saturday October 10, 1891, was chosen for the initiation. Late in the evening of that day three blindfolded passengers were rowed in a boat on the waters of Lake Mendota. History records their names as Charles Frederick Burgess '95, George Heckman Burgess '95, and George Edwin O'Neil '96, the last-named being better known as "Pat." Officiating at the oars was

William A. Baehr '94. All four of them stayed under the spell of that night's happenings for more than half a century.

Early in his college career, Charlie discovered that not all a man's education takes place in the classroom, nor even in the laboratory. Throughout the world, almost daily, things were happening that were immensely important to the student of electrical engineering. One of these had happened in Pennsylvania, the very year that Charlie started in college. There, in a little shop in the town of Monongahela, Edward Goodrich Acheson created Carborundum, one of the most important of modern abrasives, by passing electrical current through a mixture of carbon and silica. Doubtless all of Professor D. C. Jackson's students heard about this notable feat of electrochemistry; and it is safe to assume that Charlie did not overlook the fact that within a few months of the discovery, a company to manufacture the new product had been organized, and incorporated for $150,000. The inventor of Carborundum was to become one of Charlie's friends; and a half century later, one of his most cherished possessions was to be the Acheson Medal.

Another confirmation of the significance of electrochemistry came in May 1892, when Morehead and Willson, fusing lime and coal tar in an electric furnace, made calcium carbide and thence produced acetylene; and never to be forgotten was the dramatic story of how Charles Martin Hall, in 1886, toiled in his father's woodshed and made the world's first cheap aluminum.

Vacation periods were no exception to the rule that every waking hour should be a learning hour. Home in Oshkosh for a summer vacation, Charlie worked for the electric light company, and walked for miles, changing the carbons for the arc lights that hung in the streets. It was then that he learned to climb poles, and fix electric wires—many of them live wires. He was never quite sure whether this was learning the easy way or the hard way.

Another summer he liked to recall was his "book-agent" summer. Frank V. Cornish '96 took Charlie and two other young fellows out with him to sell a special edition of Cram's Atlas to the farmers of Minnesota. The others were William S. Kies '99 and John Lynch. The price of the atlas was $5.75 for cloth binding, $7.25 for morocco, and the salesmen got 50% commission; or, putting it more attractively, they made 100% profit. Billy Kies did pretty well; the first day out he sold five atlases, all to Norwegians. Lynch and Burgess ran into a great deal of sales resistance, and after a few days the practical Charlie decided that what the farmers really needed was not maps but men; and for the rest of the summer he labored, not without recompense, in the hay and grain fields of Minnesota. It should be said that most of his work was done on the farm owned by Cornish's father. A contemporary recalls that "Charlie was quite susceptible to the charms of one of Cornish's six pretty sisters."

The summer's experience did not help him much with his electrical engineering, but it did teach him something about selling. He made

Beta Theta Pi Group

Top Row—Joe S. Coe, Charles A. Libbey, George Swiler, Henry W. Freeman, John R. Richards, Ossian T. Waite, George F. Downer, William N. Smith

Middle Row—Ben E. Tilton, George P. Robinson, Walton Pyre, Charles F. Burgess, Louis M. Ward, J. F. A. Pyre, Charles C. Case, Charles A. Phelps, Harry J. Noyes, Ernest S. Park

Bottom Row—Earl May, George E. O'Neil, Harry R. Crandall, George H. Trautmann, Henry A. Perkins, James G. Smith, George H. Burgess

a solemn resolve that if he ever got into the manufacturing business, he'd try to make a product that people wanted.

Charlie's months on the farm, besides serving as a vacation with a pleasant touch of romance, brought him plenty of good food, a healthy coat of tan, and enough money to buy a second-hand typewriter. With this machine, a sturdy ancient Remington, more money could be earned. Word soon got around that Burgess was a neat typist, who, for a modest fee, would copy a fellow's thesis, or even a whole book. There were some who said that if the fee was not too modest, Burgess might also improve the English, or even add a good idea or so. Be that as it may, the fact remains that Charlie did a great deal of typing for himself and others; and that he used a typewriter for the balance of his days. In later life Charlie recalled with pleasure that he had done the typing of many important papers and at least one book from the dictation of his friend and mentor, Professor Dugald Jackson.

Professor Jackson considered Burgess a very good secretary, and once said of him "He was studying Electrical Engineering, so he knew what I was thinking about." One winter, Charlie lived with the Jacksons, and when their small daughter saw her father pecking slowly at a typewriter, she said, "Daddy, why don't you do it fast, like Mr. Burgess?" Charlie had practiced till he acquired a pretty good speed. It was the same with his stenography. By the aid of a book he learned the Pitmanic system of shorthand, and tested his speed by taking down the sermons at church. When his mother heard about this she was not at all pleased. It seemed to her that "The pen of a ready writer" referred rather to the psalmist's tongue than to the clever performance of a youthful reporter.

The fact should not be overlooked that Burgess received much of his early instruction in applied electrochemistry from Dr. John E. Davies, noted mathematician and scientist, who had been teaching at Wisconsin ever since 1868. The part played by Professor Davies and other able teachers in influencing Burgess's career will be seen in later chapters.

In 1892, Charlie and George saw their names mentioned for the first time in the University year book, the *Badger*. Besides being listed as freshmen under their respective courses, they appeared as follows in one of the humorous footnotes which were supposed to lend charm to the advertising pages:

Burgess Bros.—"Taken from the county jail."

On another page, Louis Kahlenberg '92, destined to be a valued teacher and friend, came in for some less ribald joshing. In the Senior Class Statistics, his residence was given as Two Rivers, Wisconsin, his course General Science, his age 29 (it was actually 22), weight 180 pounds, height six feet. Then, "Self-Estimate—A Man of Dignity," "Most Prominent Characteristic, His Taciturnity," and "Motive in Life, To be a Professor of Chemistry."

In a more serious section of the book appeared a good picture of Professor Storm Bull, with the comment, "To Professor Bull, more than

Electrical Laboratory and Shop Building, University of Wisconsin, where first Applied Electrochemistry Laboratory was installed in 1895-6.

Chemical Engineering Building entrance, University of Wisconsin, showing name installed by Burgess

to any other man, belongs the honor of bringing the College of Engineering up to its present position."

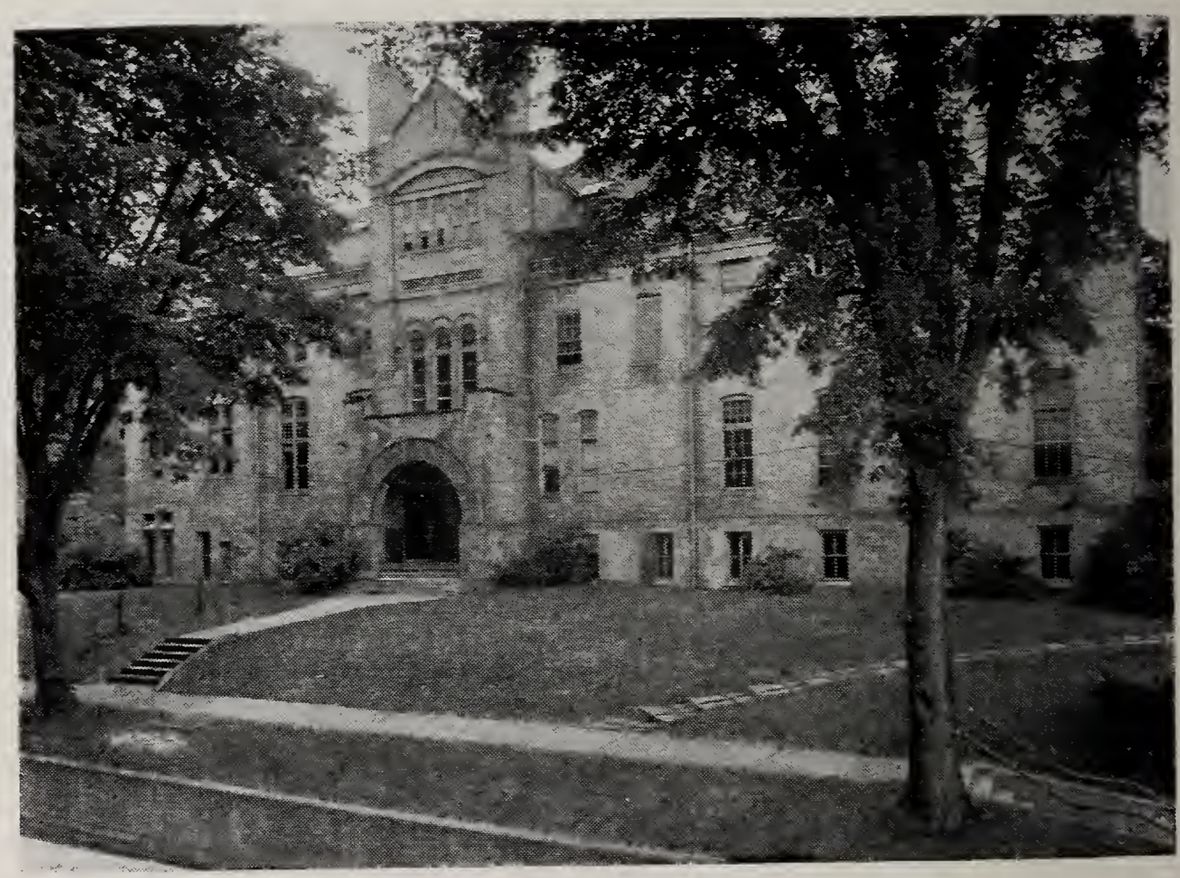
One of the memorable years in Charlie's life was 1893, year of the World's Columbian Exposition, better known as the Chicago World's Fair. He made a point of visiting the Fair, and enjoyed every minute of it, and every mile. As might be expected, much of his time was spent in Machinery Hall, where was displayed the greatest collection of electrical and other mechanical wonders ever brought together. Many of the devices exhibited did not come into general use until years later; but there they were—a wonderland of science—in working order so that all might see.

As Charlie stood spellbound before some of the electrical marvels, he may have rubbed shoulders with another young man, his junior by only a few months, who came there not as a visitor, but as an employee of the Fair, a chair-pusher. This other young man, who would have been eager to "talk electricity" had he been given a chance, was in time to become one of Charlie's valued friends; his name was to become a household word in connection with one of the scientific triumphs of the 20th Century. Radio pioneers throughout the world were to know and respect the name of Lee de Forest.

Many years were to pass before de Forest and Burgess would really meet; and so the one continued pushing chairs, and the other continued to enjoy the thousand-and-one attractions of the Fair, including the Carborundum exhibit, tended by Edward Goodrich Acheson in person. Charlie was keenly interested in hearing that this exhibit had been made possible by a remarkably quick response to one of Acheson's first essays in advertising. Early in 1893 Acheson had sent tiny sample Carborundum wheels to 12,000 dentists; each wheel was embedded in a card bearing the words "Try me wet or dry." On the back of the card was a price list. Within a week enough orders and money had come in to pay for the wheels and the entire advertising campaign. Then a dental supply house, having heard from some of the 12,000 dentists, ordered $5,000 worth of wheels; and with this money Acheson financed his exhibit at the Chicago Exposition. After that, the sky was the limit.

All in all, the summer of 1893—the "World's Fair summer"—was memorable. On the one hand it helped Charlie realize, more than ever before, the dignity and worth of the sciences he was studying; on the other hand, it gave him a new concept of the ever-increasing power of American business, and the almost imperial control that a group, or even an individual, might exercise over an entire industry. It must be very satisfying, he thought, to possess such power. But—and the "but" was a weighty one—suppose such power should be used unwisely, or unfairly, what then?

In 1894 the answer came. Great industrial power not only *could* be used unfairly; it had been; and Charlie's father had been one of its victims. For several years the elder Burgess had been part owner of a small but prosperous manufacturing concern in Oshkosh. A powerful competitor, having failed in efforts to buy this concern, proceeded to force



Chemical Engineering Building, University of Wisconsin

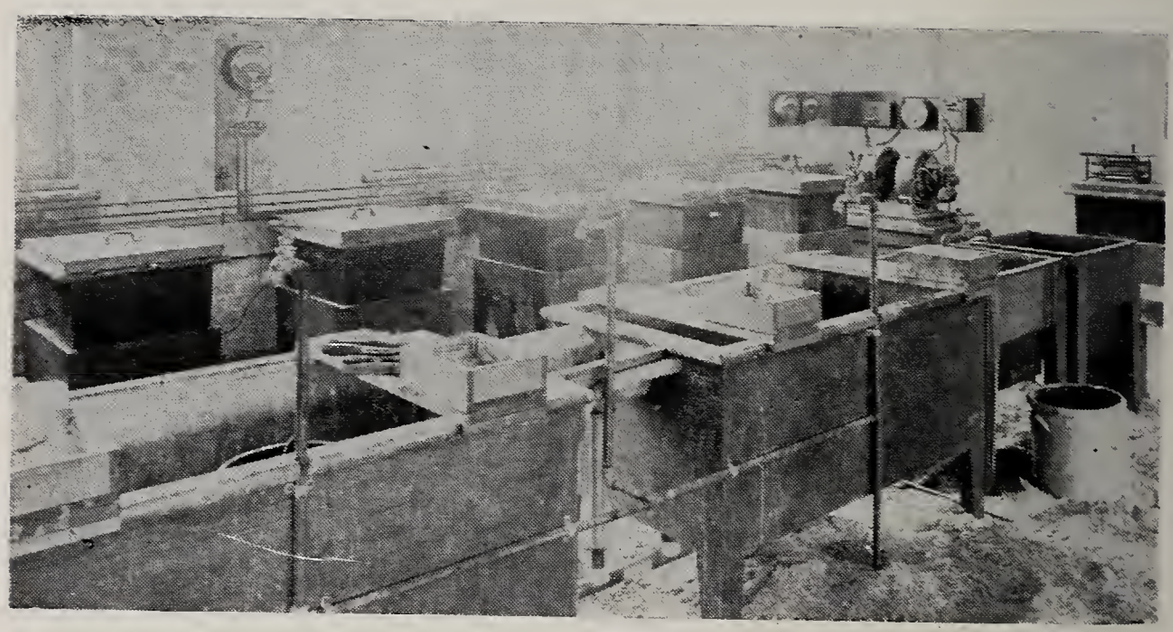
it out of business, by the familiar method of dumping goods on the market below cost. In at least one case large quantities of the Oshkosh firm's own product were bought up, and offered locally at cut prices. These tactics confused and demoralized the trade, and the smaller concern was forced to sell out, on terms dictated by its destroyer. Charles F. Burgess had seen what can happen when men, without any restraint, are able to have their own way. And he acquired some very definite views on the subject of monopolies.

If Charlie took the trouble to make a list of the "trusts" created in the half-dozen years preceding this event—and he probably did—he must have wondered whether to be more amazed or amused. In spite of constant threats of corrective legislation, leading in 1890 to the passage of the Sherman Anti-Trust Act, the trust parade rolled merrily along. Monopolies, more or less effective, were created to cover such foods as sugar, sweet potatoes, soda-crackers, and rice; also such other items as whiskey, beer, and plug tobacco. There were separate trusts to control the output of leather, sole leather, oak harness leather. Others took in pottery, rubber boots and shoes, school furniture, kindling wood and coffins. And there were many more, all the way from ice to cheap novels. The slogan of these people seemed to be "Let us get into business, and let everyone else stay out." Charlie said then, and ever afterwards, that such methods must not be; he insisted that industry should be free from private monopolies, and, as far as possible, from regulation by the state.

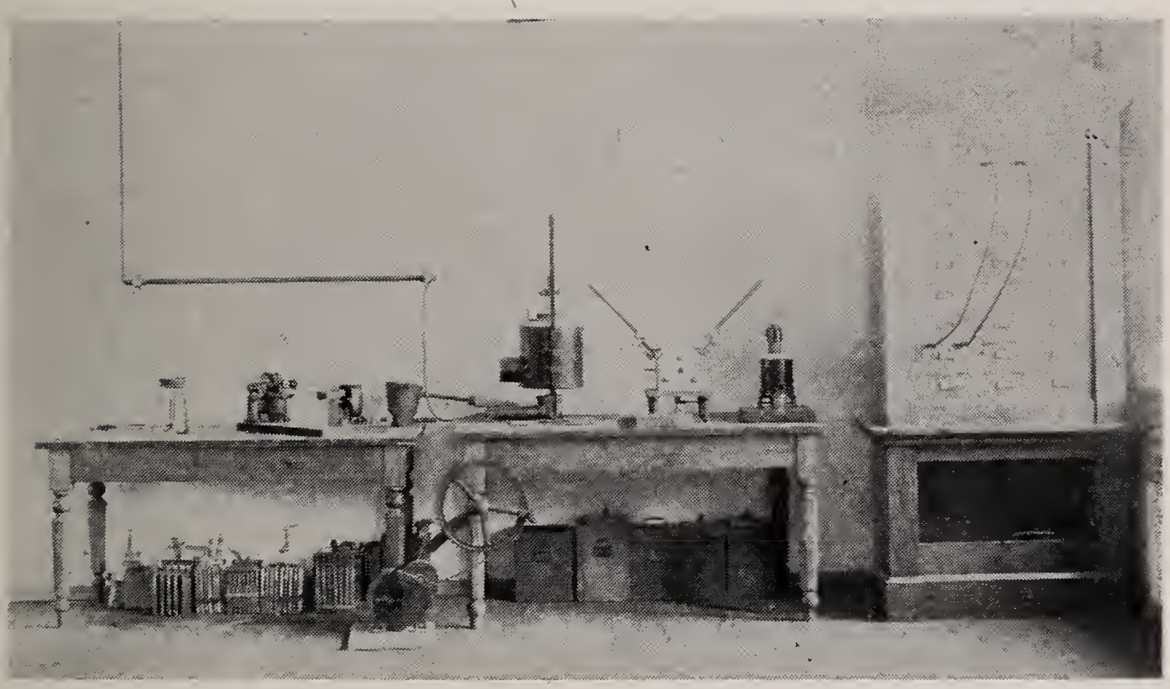
Charlie's father, always a philosopher, did not allow his tussle with the trust to disturb him unduly; he was soon busied with another enterprise, and Charlie himself was equally busy with his studies, plus an occasional social event, indoor or out. Some of this social life consisted in staying at home in the old Beta House, 614 Langdon Street, where with his brother George he occupied a large back room on the third floor. This room, popularly known as "Third Floor North," was the scene of many informal student gatherings. A smaller room, third floor front, was the lodging of "Pat" O'Neil, already referred to; and another member of the congenial group was Earl Chapin May, a young fellow with a picturesque circus background and a flair for music and writing. They all took an active part in the social life of the campus, and in the current *Badger* at least two of them are mentioned in a girl student's verses entitled "After the Prom:"

George Burgess condescended, too,
To ask me for a dance.
* * * * * * * * * *
And then that waltz with "Pat" O'Neil—
My! But that was bliss!

Music for the "prom" and similar college dances was furnished by small orchestras, but when the students were invited to dances in people's homes they usually had to be content with the strains of a piano, played by one of themselves or by a member of the family. That is, unless the



Original Electroplating Laboratory, University of Wisconsin, installed by C. F. Burgess in 1895-6



Original Electric Furnace Laboratory, University of Wisconsin, installed by C. F. Burgess in 1895-6

family owned a musical treasure proudly advertised in the *Badger*:

> The Regina Music Box. The only music box manufactured in the United States. Plays an unlimited number of tunes on a steel comb, and surpasses the finest Swiss music box made. Brilliant and rich in tone. Suitable for parlor, dining-room, or to dance by.

Next door to the Beta House lived Mrs. Frawley, hostess of a famous boarding house patronized by the Betas and others. Mrs. Frawley, often referred to as Madame, owned both houses. Ernest A. Stavrum '97, who recalls that the Betas occupied two full tables at Mrs. Frawley's, and that he often saw Burgess there, continues:

> Madame la Frawley was indeed quite a remarkable woman, certainly an excellent cook, with her sister, Mrs. Baker, serving the best student table at the University.
>
> She was a woman of handsome figure and comely features, with smiling Irish blue eyes, but tending strictly, firmly to business. 9 o'clock Saturday or Sunday morning meant just that—not 9:05 or 9:10. She must have been a real beauty in her day, a belle of the 70's or 80's.

In 1894 Burgess became president of the newly-created Camera Club, perhaps not so much from any special desire to take pictures as from the fact that some of the members were important and interesting men. The photographers included such faculty members as Professor S. B. Babcock, famed inventor of the Babcock milk-tester, and Professors C. I. King, Storm Bull, J. G. D. Mack, and B. W. Snow, all of them real "characters", all of them sources of knowledge and inspiration.

A photograph of Charlie Burgess taken in 1894 shows him as a member of his class football team, the "1895 Engineers." He makes a fine figure of a man, with a good head of hair, a neat moustache, and a look in his eye which leaves one in doubt as to whether his gaze was piercing or wistful. In the same year he was center field on his class baseball team.

Some student activities were not reported in the *Badger,* or anywhere else. For example, the fact that for an entire winter Charlie rose early every morning, without disturbing his brother or the other slumbering Betas, and walked to the old University Hotel, at 450 West Gilman Street. He went there not for breakfast, but to stoke the furnace and to perform other janitorial functions. This was one of his means of "working his way through college." He did it cheerfully, and kept a steady eye on the future.

On a very cold day in March 1895, Charlie and George gave a distinguished stranger an exciting ride across the Lake on their iceboat. The stranger was L. F. Loree, famed railroad man, who later became president of the Baltimore & Ohio Railroad. Mr. Loree was in Madison to address the engineering students on "Emergencies in Railroad Work." He never forgot his breath-taking ride on the lake; he probably classified it as an emergency in iceborne travel. In any case, he told Charlie and George to write to him if he could help them at any time. A year or so later, George

did so, and thus secured the first of his long line of worthwhile railroad positions. The tale that Charlie also applied to Mr. Loree, with similar results, is a legend, probably invented by some friend to "improve" the story. Charlie did not profit directly from the incident; but he couldn't help noticing it as illustrating the value of friendship with influential men.

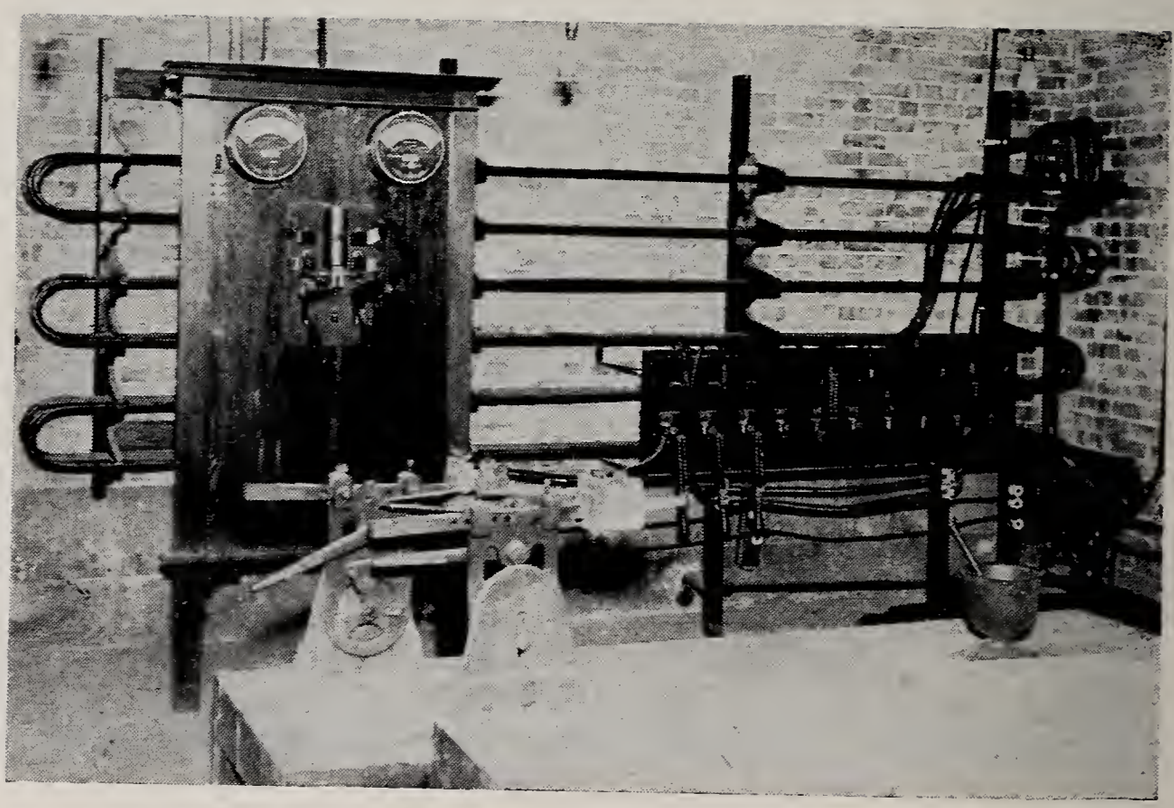
Among other special lecturers at Wisconsin during the school year 1894-5 were Alexander Graham Bell and Elisha Gray. When one learns from *Who's Who in America* that Bell "invented telephone, for which patent was granted Mar. 17, 1876," and that Gray "invented the speaking telephone, 1876," one can sense the thrill experienced by Burgess and the other budding electrical engineers at hearing the famous rivals—doubtless on separate occasions—discussing their respective claims. It is probable that Burgess also learned a great deal about the wise use of American patent facilities, and the vital importance of keeping detailed written records.

While he listened carefully to these and other lectures by scholars, scientists and industrialists, it must not be supposed that he was always a mere listener. Sometimes he had something to say; and his remarks might be either serious or otherwise. From an item in the *Madison Democrat* of Saturday April 20, 1895, we learn that:

> The joint meeting of the literary societies of the University was a success in every sense of the word. . . . Mr. C. F. Burgess convulsed his hearers with an exceedingly humorous toast. This was one of the best features of the program.

Unfortunately the news item does not let us in on the joke, or we might find ourselves convulsing just as readily as a certain audience did in the Nineties.

"The Nineties!"—a period in our history often qualified with such adjectives as Naughty, Gay, or Golden. Judging the Nineties by their fruits, the title Golden seem to fit them best. The final decade of the Nineteenth Century was an era of ferment, of change, of more or less uninhibited progress; and nowhere did the pulse of progress stir a quicker response than in the State of Wisconsin. Symptoms of this response were seen throughout the state, in politics, agriculture, education and journalism. Wisconsin journalism recorded progress and played its part in initiating progress. In Milwaukee, in the Nineties, the *Journal* was bold enough to employ a woman in its editorial department, and to entrust her with the creation of important new features, such as a woman's column, a club section, and reports on special events. These features, slanted at a feminine audience, were read and appreciated also by men; indeed, this pioneer newspaper woman—her name was Ida May Jackson—found time to cover fires and accidents and county board meetings; and according to one of her friends, "she turned in copy that stood up with that of men on other papers." Around the turn of the century, she moved to the *Milwaukee Sentinel,* but not until after she had welcomed and aided a feminine colleague in the person of Zona Gale '95. Zona achieved distinction later as a novelist, but



Special process equipment in applied electrochemistry laboratory

never forgot her writing apprenticeship with Milwaukee newspapers. To the *Journal,* some time later and still in her teens, came Edna Ferber, who at seventeen had done good work reporting for the *Crescent* at Appleton. These cases were not unique, but neither were they common, and they served as signs of the progressive spirit of the time and of Wisconsin.

As the state progressed, so did the House of Burgess. Early in 1895, Fred Burgess became Chief of Police of the City of Oshkosh, a post he held for two years. He was inclined to feel better satisfied with his own advancement than with his eldest son's, and said that he did not quite agree with Charlie's current ambition, which was to qualify as a teacher. However, when Charlie graduated with a Bachelor of Science degree, his father came through with a few well-chosen words of commendation and encouragement. Charlie was often touched by the comfort and inspiration received from his parents; they made him feel that they were proud of him; and he, in turn, never forgot the sacrifices they made to send him through college.

Burgess had now put in four years at Wisconsin as a student of Electrical Engineering, and had profited greatly from his contacts with Professor Dugald C. Jackson and Dr. John E. Davies, two of the best teachers America could afford. The course in Applied Electrochemistry had added notably to his interest in batteries, an interest dating back to his high-school days, and had given him a good groundwork in electrolysis and electro-metallurgy; this in spite of the fact that the instruction then given was mostly of a theoretical nature, with laboratory work done in beakers and test tubes. Dr. Davies had also helped him a great deal in his difficulties with mathematics.

The thesis which he submitted for his Bachelor of Science degree was based on a practical application of some of the lessons he had learned. It was entitled "A Commercial Test of the Power Station of the Four Lakes Light and Power Company." This station, in Madison, supplied power for the City of Madison and for the Madison city railways. The company was later known as the Madison Gas and Electric Company. Three students were associated with Burgess in the test, and their joint efforts are represented in his thesis. The three were Edgar Willis Crane '95, George Alvin Mead '95, and Budd D. Frankenfield '95. Burgess corresponded with Mead and Frankenfield for many years.

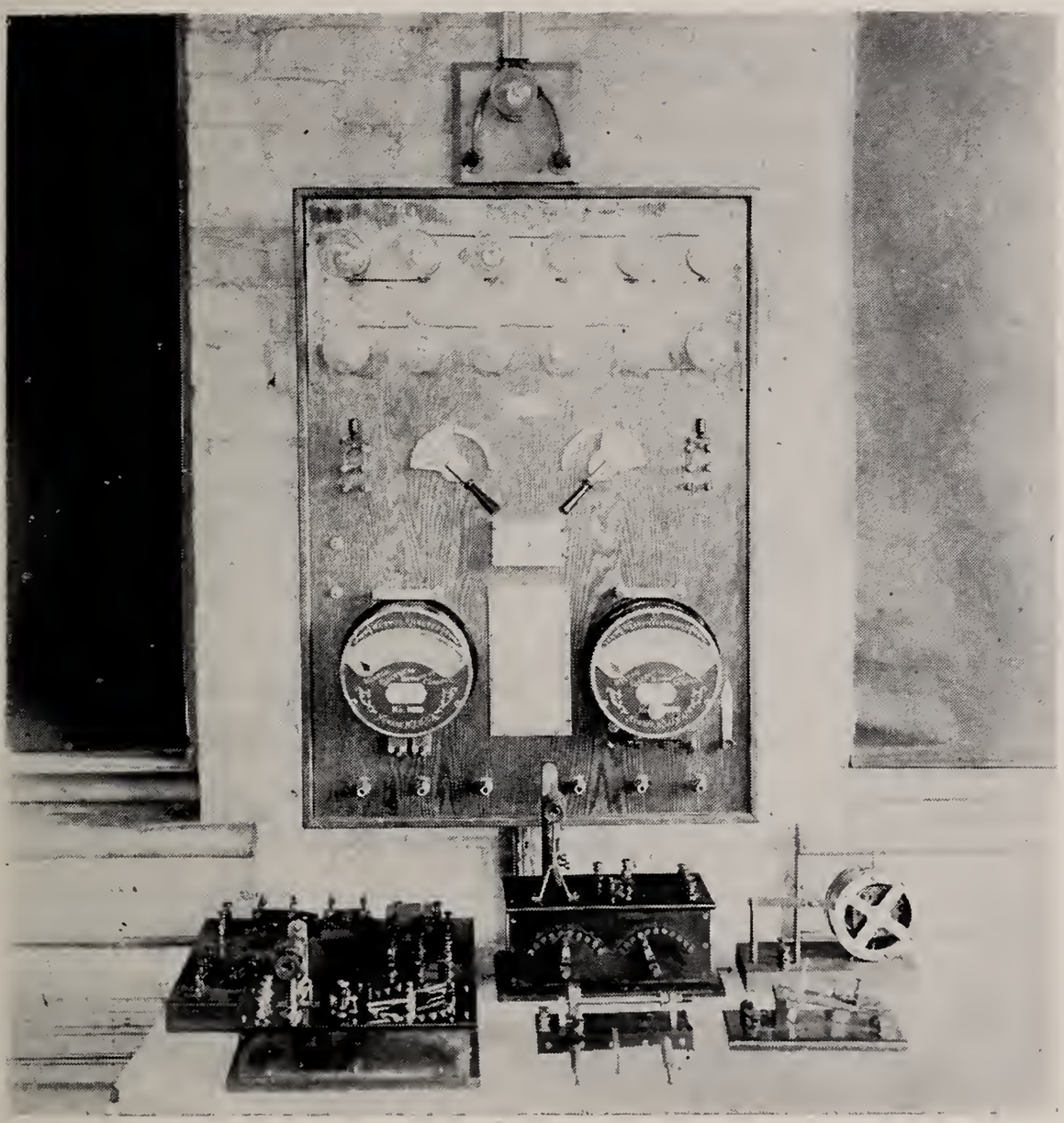
The *Commencement Annual* for 1895 printed a Class Prophecy by Vroman Mason '95 and Edith Lyon '95, a somewhat ethereal poem by Zona Gale '95, class poet, and twin reports of Class statistics by C. F. Burgess and Bessie Steenberg '95; all, except Miss Gale's verses, being in a tone mildly facetious. The Class History, by Helen A. Baker '95, printed in the 1896 *Badger,* closes with the motto of 1895, "No matter how hard the nut, we'll crack it," a sentiment which might have been uttered by Burgess himself.

Charlie's graduation year was also a depression year. Some of his friends had to drop out of school because their families could no longer pay their expenses at Madison. Those who stayed had difficulty finding

employment for the summer vacation. Then Charlie received a letter postmarked Cleveland, Ohio; it was from one of his close friends, Samuel B. Fortenbaugh. Fortenbaugh, known to his intimates as "Forty," was a Cornell man with commercial experience, who had come to Wisconsin in 1894 as Assistant Professor in Electrical Engineering. He had business connections in Cleveland, and had obtained satisfactory employment there for the summer vacation. Now he invited Burgess to follow him, and to put in a couple of months winding armatures at the plant of the Walker Manufacturing Company. Charlie lost no time in getting there, and in buckling down to work at the interesting salary of ten cents an hour, the accepted if not princely rate for inexperienced winders. The work week was supposed to be sixty hours, but Charlie was often glad to work ninety, to make ends meet.

Young Burgess had not been in Cleveland many hours before he found that although he was on the payroll of the Walker Manufacturing Company, his real boss was an amazing young man named Sidney H. Short. At the age of fourteen, Sidney Short had been a telegraph operator. Eight years later he was Vice President of the University of Denver, and a professor of physics and chemistry. While in Denver he invented a new type of motor for street railways, soon adopted by the Consolidated Street Railway Co. in Columbus, Ohio, his birthplace. In 1889 he moved to Cleveland and there organized The Short Electric Railway Company, with the aid of his friend Charles Francis Brush, arc-lighting pioneer. When The Short Electric Railway Company was absorbed by the General Electric combine, Professor Short acquired an interest in the Walker Manufacturing Company and used its plant for the manufacture of his motors and generators. When Burgess went to Cleveland, Short was only 36, and was taking out patents at the rate of thirty or forty a year. Charlie felt it a privilege to work for him, and marveled that any man could, with such apparent ease, move from scholarship, through invention, to industry. He could not help noticing, however, that this maker of generators was himself a very dynamo of energy.

Evenings were sometimes spent at the homes of fellow workers, and in conversation with them Charlie learned a number of lessons that helped him, many years later, solve some of his own problems in labor relations. He was learning also, at first hand, the meaning of long hours, low pay, and unattractive work. In a letter to his twelve-year old brother Kenneth, then visiting his grandparents in Nova Scotia, Charlie wrote: "I get my hands and face pretty dirty sometimes, especially on hot days"; and added, "I have been rather lonesome." These words were written Sunday, August 11, 1895. On the evening of Tuesday the 13th, when Charlie reached his Euclid Avenue lodgings, his landlady called to him, "Mr. Burgess you have a letter from Madison." Sure enough, there it was, in a small envelope imprinted "University of Wisconsin, Office of Board of Regents." Charlie opened the letter without waiting to clean up (his finger marks were to be visible half a century later), and this is what he read:



Applied electrochemistry laboratory with special electrical instruments designed by C. H. Burgess in foreground.

Mr. C. F. Burgess,
1194½ Euclid Avenue,
Cleveland, Ohio.

Dear Sir:

I take pleasure in notifying you that at a recent meeting of the Board of Regents you were duly appointed to the position of Assistant in Electrical Engineering for the ensuing year, at a salary of three hundred dollars ($300).

Very truly yours,
E. F. Riley, Sec.

This message fulfilled a hope—indeed an expectation—that Charlie had not felt free to mention two days earlier, in writing to his brother. The appointment had been recommended, of course, by Professor D. C. Jackson, who had promised that Burgess might help in formulating a four-year course in Applied Electrochemistry—a subject hitherto not given a leading place in any curriculum.

Hastening to Fortenbaugh with the good news, Burgess found that "Forty" also had received a letter—from Professor Jackson. Fortenbaugh was given "the job of developing an electrochemical division, with equipment." It was evident that the two were expected to collaborate, and Burgess, glad that he would not have to face his new responsibility alone, welcomed the aid of his friend. America's first comprehensive course in Applied Electrochemistry, soon to be established at Wisconsin, then began to take form in the minds of two young men summering in Ohio.

3.

Assistant at Wisconsin 1895-1896

WHEN Dugald C. Jackson made Burgess and Fortenbaugh responsible for establishing a four-year course in applied electrochemistry, he was breaking with tradition. They were electrical *engineers;* they were not primarily *chemists.* This emphasis on engineering represented a trend of real importance. The words tell their own story. *Chemistry* suggests pure science, *engineering* suggests action. The new course was to be activated to meet the needs of industry.

New needs called for new methods; and Burgess, fresh from four inspiring years under Professor Jackson, was eager to play a worthy role in this drama of educational reform. He could not help knowing that some teachers had the reputation of plodding along, year after year, leading successive groups of students through unchanging textbooks, just as a guide leads new groups of tourists through unchanging museums and catacombs. But he would never be that kind of teacher. He would find things out for himself, and encourage others to do the same; and in so far as he used textbooks, he would use them not as masters but as servants.

Meanwhile there were few books relating directly to electrochemistry, and no textbooks suitable for classroom use. This proved to be a blessing in disguise, for it would oblige Burgess to draw on his own resources, and to build up his lectures and class material from scratch.

It was an advantage to be able to talk things over with the more experienced Fortenbaugh, and their evening conferences sometimes lasted for hours. The two men, still in Cleveland, planning the equipment of a pioneer laboratory for applied electrochemistry, knew that they would be forced to practice strict economy. Equipment was meager now; it would probably be meager for a long time to come; in this depression year, finances at Wisconsin were severely limited, and every dollar was wanted by several departments. The redoubtable Charles I. King, Professor of Mechanical Practice and head of the Machine Shop, was battling for an appropriation for a new milling machine, while Burgess clamored for a few hundred dollars for an electro-plating dynamo, some enamel-lined iron tanks, and other necessary equipment. Both claims were granted, the equipment was ordered, and Burgess and "Forty" were soon back in Madison.

Burgess, aged 22, stood slightly in awe of King, who was 48. King, a former Cornell man, had been teaching at Wisconsin ever since 1877; his machine-shop career had commenced when Charlie Burgess was a baby. Installing equipment was an old story for him, and the easy confidence with which he went ahead, a confidence based on long experience, made a deep impression on the young instructor. Burgess had been assigned laboratory space above the machine-shop, and there for several days, as he put in place his dynamo and tanks, he seemed to be the busiest man in Madison. Then came the task of mixing up the electrolytes for plating copper, nickel, zinc, and silver, an occupation extending well into the night. At this point we are able to continue the story in Burgess's own words:

> The following morning as I entered the building with high hopes as to what my laboratory students and I were going to do, I was met at the door by Professor King who had a disagreeable glint in his eye when he said "Burgess, come out here, I want to show you something." He led me to his new milling machine and said "What do you think of that?" I was speechless, for there before me was his pet machine coated completely with a beautiful layer of bright copper.

Manifestly the copper-sulphate solution had leaked through from the floor above. But how had it escaped from an iron tank, through an impervious coating of vitreous enamel? The answer is that the coating was *not* impervious. It was dotted with pinholes, which let the copper solution through, and—again in the words of Burgess:

> The iron tank was converted into a sieve, through which the milling machine received a shower-bath of copper-sulphate solution, the result being a striking demonstration of the process of plating by simple immersion.
>
> This experience became an object lesson to me and to my students for many years thereafter.

The closing words are typical of Burgess. Recovering quickly from what must have been a moment of keen embarrassment, he presents the incident to his students as Lesson Number One. If he hadn't "planned it that way," at least he would turn it to profit; and no student of his would ever miss the point of the story. It may be well to mention that before long a new item appeared in the list of Burgess's equipment; it was "one lead-lined tank for copper-plating."

Faced with the responsibility of helping to establish the first full course of Applied Electrochemistry in the United States—perhaps the first of its kind in the world—Burgess tells how he undertook to read all of the literature on the subject in both French and English. This may have seemed possible in 1895; for while electrochemistry had been noticed and mentioned for almost a century, references to it *by name* in scientific publications had been relatively few. Davy, in 1807, had spoken of "the powers of electro-chemical analysis." An anonymous writer in 1829 had furnished a definition, in the style of the

period, combining vagueness and elegance: "Electro-Chemistry. . .one of the connecting branches between remote divisions of the Philosophy of Nature." Michael Faraday, virtual founder of the science, was more interested in the early 1830's in practising electrochemistry than in writing about it. James Wylde, as late as 1865, was still discussing "the laws *of what has been termed* electro-chemical decomposition." Now thirty more years had passed, and though the science had acquired a better representation in its theoretical literature, Burgess still complained of a shortage of practical articles and books. It is true that works with promising titles were listed in the library catalogues, but Burgess insisted that most of them did not meet the needs of the classroom. However, he read everything he could find, and kept his students in touch with current progress.

He soon found that it was one thing to read, and another to remember; and he promptly started to build an efficient card index of all the literature relating to his subjects. He included not only electrochemistry, but chemical engineering, metallurgy, electrical engineering, and chemistry. He kept this up for a number of years, and the time he spent on it was one of the best investments he ever made. When the technical literature began to increase so rapidly that no man could keep up with the task of indexing it, Burgess had to quit; but soon such aid was available from other sources; for example, from the American Chemical Society, in its *Chemical Abstracts* instituted in 1907, and from other organizations offering indexes and abstracts in various fields of science.

The guiding principle of Burgess's teaching had come to him first in theological terms, in the days when he listened to eloquent preachers holding forth on the emptiness of mere faith unsupported by works. It had been repeated in scholastic terms when Professor Jackson urged that theories should be promptly turned to practice. It was proclaimed again as the title of the now unfolding course; not Electrochemistry but *Applied* Electrochemistry.

The keynote of "application" was sounded consistently, and stressed by frequent reference to the feats accomplished by other Americans, often with equipment as simple as that used by Burgess and his students. Dramatic examples included Hall, cheap aluminum; Acheson, carborundum; Willson and Morehead, calcium carbide and cheap acetylene; Acker, caustic soda by electrolysis of molten salt. All these men, Burgess was able to show, were young; their average age was well under thirty. And—mark well—their electrochemical discoveries, inventions or adaptations had in each case led to the acquisition of wealth.

Not every experiment could bring quick results in fame or money, but Burgess's little group of students managed to spend many interesting hours tackling everyday problems and sometimes solving them. "The course," said one of the students, "has a lot to do with electroplating." Electroplating did not seem very sensational; but in many industries it was an art of real importance; and electroplaters throughout the world have profited from the research, started in the

Nineties, by those earnest young men who worked in a simple laboratory above a machine shop.

Burgess found time to do a great deal of reading, much of it late at night. Often, when reading a technical book, he would mark passages which might help him in his teaching. Many penciled notations appear in a copy of Noll's *How to Wire Buildings,* which he bought as soon as it appeared in 1895. Also in Abbott's *Electrical Transmission of Energy,* of the same year. In the margins of the Abbott book he seems to be preparing for a classroom quiz of his students, with such practical questions as "What is meant by balancing?", "In what different methods may storage cells be used as an auxiliary?". On Page 1 he writes "Find mistakes"; and sure enough, some errors are found and marked. In another book he found mistakes in a table of boiling points which had been copied from one work to another for fifty years. Apparently no one before him had taken the trouble to check the figures.

Not to be forgotten is another book, which had been one of Burgess's treasures ever since it appeared in 1891. This was Carhart's classic work, *Primary Batteries.* Having used it as a textbook under Dr. John E. Davies, he was to use it a little later on in teaching others. Even in his first year as an instructor, when he was handling such subjects as electrolysis and electro-metallurgy, he liked to talk to his students about the importance of the humble dry battery; and it was humble indeed in the minds of these young men, who, as he said, "were dreaming of 1000-kilowatt generators, power-transmission lines, and electric railways."

Burgess often described the dry battery as a device which made people pay 25 cents for 15 watt hours of energy, when at the same cost a power station could supply a thousand times as much. The thousand-to-one premium was paid, of course, for *portability.* He reasoned that the way to reduce the premium—perhaps materially—would be to make a more efficient battery; and for years to come, in classroom and laboratory, the quest for a better battery was carried on with undimmed enthusiasm.

4.

Instructor at Wisconsin 1896

BURGESS wrote his parents early in 1896 announcing that he was soon to have a new title, "Instructor in Electrical Engineering," and to prove how much better this was than being a mere "Assistant," he pointed out that the new title would boost his salary to $450.00 a year. This promotion meant real progress, and the modest salary could be augmented by payments received for outside work, often for Professor D. C. Jackson and his brother when they needed assistance in their electrical engineering consulting projects. But Burgess began to wonder whether by leaving the University, he could better himself. Professor Jackson assured him that it would be wise to stay. The country was still suffering from a financial depression; only a few jobs were available, and they were more or less uncertain. Charles sat down and wrote his father all about it, and in due course he received a reply, dated May 9, 1896, neatly penned on official stationery of the City of Oshkosh with the imprint "Fred Burgess, Chief of Police." It was a fatherly letter of the "use your own judgment" type, and ran in part as follows:

> Hardly worth while to worry about the summer's business. Something, no doubt, will turn up. There is always a place for an *earnest* man, and I guess you'll find yours.
>
> About the prospects for another year, and taking up with the suggestion of Mr. Jackson, I hardly know what to advise. "A bird in the hand" and so forth, must be considered.
>
> The position you now occupy, and further the one you *would* occupy under the new deal, would no doubt enhance your value in any future place you might be called to fill.
>
> Best to look the matter over carefully before you decide. Let me hear from you.

"Summer's business" referred to the annual problem of how to earn money during the summer vacation, a problem which in 1896 soon solved itself. For in less than a week after receiving his father's letter, Charles wrote to his mother:

> I think in all probability I will conclude to remain here a couple of years longer, as the prospects seem very good, and in case everything turns out as I expect, I will probably spend my summer in Madison, studying for my future work.

> My school work has eased up very much, and I am taking work in chemistry, so that I spend half my time in teaching and half in being taught.

He was being taught by a very capable teacher, Dr. Louis Kahlenberg, and he supplemented what Kahlenberg taught him by reading many worthwhile books. One of these was an English translation of a Russian book issued 25 years earlier by Mendeleeff with the simple title *Oznovy Khemii,* or *Elements of Chemistry.* This translation, later retitled *Principles of Chemistry* to avoid any suggestion that it might be a mere primer, contained Mendeleeff's original presentation of the famous Periodic Law with its table of elements grouped according to their atomic weights. Burgess knew about the law, but he had not read the book; and, as recalled by Dr. Dugald Jackson:

> When Burgess got hold of that book he was fascinated. When he found it one evening he was standing under a light. He opened the book and stayed there for hours, reading and reading, and still standing.
>
> He went into everything that way—wholeheartedly and with great judgment.

These were happy days. Burgess was very busy, teaching and learning, getting his new equipment into shape, carrying out all sorts of experimental work, laying the ground for possible inventions and advances in the electrochemical field. He was liked and frequently commended by his chief, Dr. Dugald Jackson; and he had been promoted from "Assistant" to "Instructor."

His pride in his new title was somewhat shaken by an unexpected telephone call. It was from the secretary of Doctor Charles Kendall Adams, President of the University. All she had to say was that the doorbell at President Adams' house was out of order, and that presumably something should be done about it. Burgess's reaction can best be described in his own words:

> Feeling that the dignity of the position which I was holding had been invaded, and also realizing that my own doorbell had been out of order for many weeks, I curtly advised the secretary to call in an electrician.

So there! In later years, Burgess laughed about his wounded dignity. "It was a mistake on my part," he used to say. But in the circumstances it was a natural reaction; and apparently it did no lasting harm.

In his letters home, Charles probably said nothing about the irritating door-bell incident; but he did keep his parents well informed about most of his activities, scholastic and social. That there was a social side to his university life can be gathered from a letter he wrote his mother in May, 1896:

> I have been getting my money's worth out of my dress suit this year, and although I don't spend much time and money rush-

> ing girls, I am invited out quite a good deal. It must be because it is Leap Year.
>
> Last week I went to a party given by one of the girl's fraternities, and had to compose a poem for the occasion, and mine seemed to take as well as most of them. Think of me writing poetry.

Life in the Beta House continued to be very pleasant, but Burgess had often wondered whether, in the circumstances, it was the best place for him. In September 1896 he wrote his mother:

> I have made up my mind not to bother with society any more than possible. . . . I am going to try living alone.
>
> I am looking for some way to increase my earnings, and will probably strike something before long. A Milwaukee man wants me to look after his son during the school year, and see that he goes to his classes regularly and does not visit saloons, etc., and if he is willing to accept my terms I will earn about $1.00 a day extra.

Mother Burgess doubtless approved the idea of Charles helping another young man shun the temptations of a strange city. We are not informed, however, as to whether the Milwaukee man went through with the deal. It should have been worth a dollar a day to save his son from the etcetera, to say nothing of the saloons.

Burgess's new quarters consisted of "two rooms with all conveniences *and board,*" for which he paid six dollars per week. With him, of course, he took his trusty Remington, now needed almost daily for school work, social correspondence, and—never to be overlooked—remunerative work on the side. The result of some of this work he now had the satisfaction of seeing in printed form; it was the book, *Alternating Currents and Alternating Current Machinery,* by Professor D. C. Jackson, jointly with his younger brother J. P. Jackson. Burgess claimed jokingly that this book was "written by myself, typewritten from copy furnished by Professor Jackson, I furnishing the technical skill, and he furnishing the language and what thoughts the manuscript contained."

Noting the interest with which the Jackson book was received (it quickly became known as "A.C. by D.C."), Burgess resolved that as soon as possible he would try to make himself known through writings presented to the scientific and professional world. He had recently been elected to associate membership in the American Institute of Electrical Engineers, and one of his many ambitions was to see papers by himself published in that society's transactions. Election to the A.I.E.E. was not open to just anyone; it was an honor which had to be earned. Burgess had probably been recommended by Professor Jackson. In August 1896 he was elected a member of the Society for the Promotion of Engineering Education; he was keenly interested in the aims of the society, and participated energetically in its activities. [67, 69,78.] He served on its book committee for a number of years.[70]

In the same summer, Burgess was offered a professorship in Electrical Engineering at the University of Missouri, "with quite an

increase in salary," but, as he wrote to his mother, "I concluded that I had better hold on here a while longer." This decision showed good judgment. The very fact that he seemed desirable to Missouri proved that he was known to be making good at Wisconsin; and with Professor Jackson to guide and encourage him—the encouragement being expressed in frequent pay raises—the inducements to "hold on" were strong.

Toward the end of the year Fred Burgess wrote his son a long letter, in the course of which he said:

> I hope that you will have made more important noise in the world than I have when you arrive at my age. Every fellow has to make his own mark and blow his own trumpet as he passes along.

This letter was written four days after Fred Burgess reached his 63rd birthday, and when Charles was 23. As a matter of fact, the elder Burgess had done pretty well for himself. He had held public office under national, county and city governments, and had been reasonably successful in business. All in all, his was a record of which any citizen might be proud. But he wanted his son to make "more important noise in the world," and to blow his own trumpet. Charles, an affectionate and dutiful son, was duly impressed; when the time came for trumpet blowing, he would remember his father's advice.

5.

Instructor at Wisconsin 1897-1898

JUST as a small boy dreams of running away from home, and then decides that home, after all, is a pretty good place, so did Charles F. Burgess, time and again, consider plans for leaving the University, and then make up his mind to stay awhile. This state of affairs, which continued for many years, was perfectly logical. At frequent intervals during Burgess's teaching career he was faced with tempting opportunities to "better himself"; some of these opportunities were commercial, some educational; many of them were definitely advantageous. Why, then, did Burgess cleave unto Wisconsin?

A partial answer may be found in the fact that Wisconsin permitted its technical men to do outside work. This not only added to their incomes, but added to their experience and knowledge. It also often increased their value to the University. But for a comprehensive answer to the question as to why Burgess stayed on, we might have to insert, as a relevant exhibit, a history of the University of Wisconsin, and a statement of the part which, in its first half-century, that university played in the spiritual progress of the nation. In place of such a history and such a statement, let us be content with a single sentence, and try to define Wisconsin as representing open-mindedness, academic freedom, the spirit of progress. Some scholars tell us that they are uncertain as to the exact import of the University's ancient motto, *Numen Lumen;* but the simplest of us can understand the meaning of "On, Wisconsin!" The lodestone that attracted Burgess was this Wisconsin Onwardness. It attracted not only Burgess, but countless other men of active minds, teachers and students alike, who added luster to Wisconsin's record through the Eighteen-Nineties and the early Nineteen Hundreds.

Louis Kahlenberg, longtime friend, teacher and colleague of Burgess, was outstanding in this period of outstanding minds. In the fall of 1895 Kahlenberg returned to Wisconsin, his alma mater, after a busy year at the University of Leipzig. There he had earned a Ph.D., *summa cum laude;* there he had enjoyed the privilege of working in the laboratory of the great Ostwald. Though justly proud of these distinctions, Kahlenberg, then 25 years old, remained a bold and independent thinker. He dared to challenge some of the pet theories of Ostwald,

and Arrhenius, and van't Hoff, regarding electrolytic dissociation and the like, although these men—all soon to be Nobel prize-winners—were leaders in the hierachy of science. His challenges, supported by detailed and measurable research, were valued contributions, not only to science, but to the morale and prestige of the faculty and student body at Wisconsin.

Another of Burgess's associates at this time was Benjamin W. Snow, who came to Wisconsin in 1893 and remained for many years as Professor of Physics. Dr. Snow, a fellow of the American Association for the Advancement of Science, came to Madison with a long and distinguished scholastic background. He was thirteen years older than Burgess, who regarded him as one of his special friends. In the days when Burgess was president of the Camera Club, and for years afterwards, the popular "Benny" Snow was an active member. This fact is brought to mind in a brochure by Ernest A. Stavrum '97,[305] who says:

> You will be interested to know that Professor Snow left some lasting and very tangible mementos of his skill as a physicist in several panels of mounted photographs of snow-flakes, one of the finest collections anywhere. They are well worth making a special trip to the new Physics Building to view.

Murray C. Beebe, who graduated in 1897, became an assistant in Electrical Engineering in that year, and co-operated with Burgess in many fields of research. He was a member of the faculty for about seventeen years.

James Aston, another of Burgess's students, graduated in 1898 with a B.S. (E.E.), and later returned as an instructor. He made a name for himself as a metallurgical engineer, and, like Kahlenberg and Beebe, will be referred to elsewhere in our story.

Known and admired by Burgess was another famed Wisconsin teacher, Storm Bull, Professor of Steam Engineering, a member of the faculty for many years. As already pointed out, Professor Bull was in a sense the father of the College of Engineering. In addition to being a brilliant engineer and a capable and notably good-natured teacher, he was a first class musician. His presence in Wisconsin was due to the fact that he was a nephew of the violin virtuoso Ole Bull. Ole Bull visited Madison in 1879, and learned that the University needed another teacher in its Mechanical Engineering department. After discussing the matter with his friend Professor Rasmus B. Anderson '85, he wrote to his nephew, who promptly crossed the ocean, reached Madison in July, and secured the position. Storm Bull was a violincellist of more than ordinary ability, and owned a fine Amati cello. He also sang tenor, and was a member and officer of the Choral Union in Madison for years. He played a not inappreciable role in the musical life of America, and his tradition is carried on by his son, Eyvind H. Bull '95, of Chicago, musician and composer, and his grandson, Storm Bull, professor of music at Baylor University in Texas, concert pianist.

A complete roster of Burgess's intimates at any given period would make a book in itself, for he was interested in people, and they in him. We can only mention a few names in passing; and we can remember that through sixteen fruitful years, 1891-1907, a name which seems to lead all the rest is that of the founder of the Electrical Engineering Department, Dugald C. Jackson, a never-failing counsellor and friend. In later years Burgess wrote to Dr. Jackson, recalling the happy days of their close association. In one letter he recalls how in the Mid-Nineties he took to signing his name "C. Fred Burgess," and then goes on to say:

> You advised me not to part my name in the middle, and I quit, You admonished me many times, and always to my advantage.
>
> You corrected my English, my mathematics, and my general behavior; but of course there were limits beyond which you could not go. You could not stifle my enthusiasm, ambition, eagerness, and selfishness.
>
> I often wonder at your patience with my obstreporousness. I recall now how my actions may have disturbed you, and I appreciate your patience and generosity.

One phase of the "obstreporousness" has already been noticed; the phase, ever recurring, in which Burgess became restless, and felt the urge to seek his fortune elsewhere. He even thought of entering the army. In May 1898, a few days after war was declared with Spain, and Bernard E. Sunny, the General Electric Company's vice-president in Chicago, was encouraging engineers to enlist, Burgess wrote to him:

> I should be very glad to tender my services . . . my business being that of electrical engineer. I have had considerable experience in various electrical lines, and am at present instructor of electrical engineering at the University of Wisconsin.

Perhaps Mr. Sunny, understanding Burgess's value to the University, advised him against enlisting; at any rate, he stayed at Wisconsin. But he was as restless as ever. Early in June 1898, he answered a blind ad in *Electrical World.* The position to be filled was that of an electrochemist, and Burgess felt that he had better not pass it up. He applied for the post, but did not get it. A courteous reply, from The Non-Polarizing Battery Co., of New York, explained that the job would pay at the most $15.00 per week, so that the position "will probably not be to your liking." It was not. But the persistent Burgess wrote again, suggesting that his name be kept on file in case a change in conditions might justify a larger salary. In a final move to hold the interest and friendship of the firm, he adds two paragraphs:

> Do you manufacture a form of dry battery for testing purposes? If so, you may be interested in a new form of battery for such work which I have recently constructed. A battery of 50 volts pressure, in a compact form, was made at a cost of about eight dollars, and does just as good service as those which may be had on the market for $50.00.
>
> If you have not yet succeeded in getting a man to fill your vacancy, I should be pleased to send you the names of one or two men who might meet with your requirements.

So he leaves them, not as a disappointed job-hunter, but as a man of some importance who may be able to save them money or otherwise aid them. Throughout his teaching career he was willing to serve as a one-man employment agency; as a result of his kind offices, many of his students secured congenial and remunerative positions.

At this point of the story we might naturally ask for more information about the "new form of battery" mentioned in Burgess's letter. It sounds interesting. Unfortunately, however, no details are available, and we are left to suppose that the device did not prove to be of value commercially.

On June 17th Burgess applied for a position that did not exist. He had heard of the Niagara Electro Chemical Company, at Niagara Falls, New York, and wrote asking if they had any opening for a man of his qualifications. They replied briefly, saying they had "no opening such as you desire." The interesting thing about this brief correspondence is that in his letter of application, Burgess had said "My only reason for desiring to leave my present position is the preference which I have for practical work." Practical work—work in which he could apply the theories he had learned and taught—was never fully absent from his mind. He mentioned it again in another letter written on the very same day, a letter important enough, and sudden enough, to be quoted in full:

Prof. D. C. Jackson,
Madison, Wis. June 17, 1898

My dear Sir:—

I send you herewith my resignation as instructor of electrical engineering in the University of Wisconsin, this to take effect at the end of this month. My reason for so doing is due to the desire which I have of obtaining practical experience in engineering work, and is in no wise due to lack of good treatment or opportunities for advancement while here. On the other hand, I wish to thank you most heartily for the many favors which you have shown me, and the interest which you have taken in my welfare.

I hope that my work of instruction and other work of the Electrical Department for the past three years has been of a satisfactory nature as I feel that I have made a strong effort to make it so.

It is with many feelings of regret that I take this step, although on the whole I feel that it is to my best interests to do so.

Very respectfully yours,
Charles F. Burgess

Exit Burgess! Or at least, so it seems. But this is Friday, and one can never tell what may happen over a week-end. Something must have happened, for on Tuesday, June 21, the Regents of the University of Wisconsin adopted a resolution: "That the salary of C. F. Burgess be and hereby is advanced from $900 to $1200," and he was duly so informed.

Evidently the resignation had not been accepted. Quite possibly it had been written after a talk with Professor Jackson, so that the

Professor could point out to the Regents that he was losing a promising young instructor, but that a "raise" might hold him. In any case, Professor Jackson, pleased with the work his protégé had done so far in building up the electrochemical courses, wanted him to stay.

Burgess did stay. Within a few days he received the advanced degree of Electrical Engineer, for which he had presented a thesis with the simple title, "The Measurement of Insulation Resistance."[57] Within a week he was "sitting on top of the world," making what he called his first venture in publicity. This venture consisted in attending the Omaha meeting of the American Institute of Electrical Engineers and reading a paper based on his thesis but now entitled "A Capillary Electrometer for Electrical Measurements."[56] In this paper, read at the meeting of Monday, June 27th, 1898, he told how he had designed a cheap, practical modification of an instrument of extraordinary precision, invented years earlier by a French physicist, Gabriel Lippmann. The principal advantage of the Burgess model was that it was rugged and portable. Presiding at the meeting was the Institute's president, Arthur Edwin Kennelly, noted electrical engineer, for many years with Edison. This fact added to Burgess's desire to make a good impression. His paper was well received, but, as he said afterwards, not enthusiastically. However, he had made himself known, favorably, among men of importance in his own field; and in due time he was to receive a copy of what must have seemed the most beautiful piece of printed matter he had beheld—his first paper, neatly printed in the A.I.E.E. *Transactions,* Volume XV.

The capillary electrometer fascinated Burgess; he was never to lose his interest in this strange device; and it would be interesting to know if, while he was reading his paper, he realized that his life and that of the electrometer were almost synchronized. Burgess was born in 1873; and it was on a Monday in June, 1873, that Lippmann made the historic note-book entry, "Relation entre les phenomenes electriques et capillaires," recording his discovery of an electrometer of extreme sensitivity. Now, on another Monday in June, twenty-five years later, Burgess was describing his modified version of the same device, and an important practical application for it.

Burgess's presence at the A.I.E.E. meeting, and the presentation of his paper, helped him in another way, as, indeed, he had hoped. It brought him into contact with J. E. Woodbridge, editor of the *Electrical World.* Mr. Woodbridge came up after the meeting and said, "How about some articles?" Without hesitation came the answer: "I'll be glad. What sort of articles do you want?" "That's up to you, Mr. Burgess. Suppose you write about something you're actually working on right now." "Well, right now we're doing some electroplating on wood." "Good enough. That's fine. Get me an article on that as soon as you can; I'll be glad to print it." Within a few weeks, there it was, "Electrodeposition on Wood," by C. F. Burgess.[36] The $11.07 received for this article came as a welcome addition to a small salary. Before 1898 was over, *Electrical World* had bought and printed two more articles, "Electrolysis in the

Cleaning of Metal Surfaces,"[43] and "Efficiency of the Electrolytic Cell."[50] Others appeared frequently in this and other publications. *Western Electrician* carried one entitled "Electrical Equipment of Plating Plants,"[40] which caused favorable comment in the trade. Circulation of these articles was the highest type of publicity; it helped the magazines, it helped their readers, and it surely helped Burgess.

6.

Instructor at Wisconsin 1898

AUGUST 12, 1898, when Burgess wrote to his good friend Fortenbaugh describing life in Madison, he summed up his impressions by saying: "I have not yet been able to find a summer girl who will fill all requirements so I have been passing a rather uneventful summer."

Rather uneventful, perhaps, in the sense that it had not brought him the girl of his dreams; but otherwise this summer was full of interesting happenings. The very fact that Fortenbaugh had gone was vitally interesting; what Burgess had often considered doing, "Forty" had done; he had quit teaching for good, and was already getting a good start in private practice.

Replacing Fortenbaugh as Assistant Professor of Electrical Engineering was a Chicagoan, Bernard Victor Swenson. Swenson, with five years of teaching experience at the University of Illinois, had challenging thoughts to express about dynamos, the measurement of light, electric railways—and advertising. Burgess and he held many conversations, long and interesting.

One day late in August, further interest was added to the "uneventful" summer when Professor Jackson came to Burgess with a suggestion:

> "Suppose you and I take a little trip on our bicycles."
> "That would be wonderful. I can't think of anything I'd like better; had you any particular place in mind?"
> "Well, how about Oshkosh?"
> "You mean—you'd come up and visit my people?"
> "Yes, if you think it would be all right."
> "Of course it would be all right; Father and Mother would give you a big welcome."

Burgess promptly wrote to his parents about the proposed visit, and they as promptly replied with a cordial invitation. The trip was to be a new experience for Professor Jackson. He was in the habit of riding his bicycle more or less every day, but only for short distances. He had not joined any of the Century Clubs which were then springing up all over America, and which were so called because their members scorned to ride less than a hundred miles in a single day; he felt that such feats were needlessly strenuous. Jackson measured the distance from Madison to

Oshkosh, and it was exactly eighty miles—on the map. But bicycle riding was not done on a map; and by eventide, when the two travelers reached Oshkosh, they had covered enough miles of winding and sometimes rugged highway to qualify them for Century Club membership after all. Jackson said later that when they reached the parental home, "Charlie was still up and coming, but I was tired out."

A comfortable chair and a generous supper dispelled the tired feeling, and Jackson soon found himself in deep conversation with the elder Burgess, who had interesting stories to tell about himself and his associates, particularly about his fellow townsman, Philetus Sawyer. Sawyer, then 82 years old, was a colorful figure, born in Vermont, reared in New York, famed in Wisconsin. He had been Mayor of Oshkosh, member of the state legislature, U.S. congressman and senator. He had also prospered mightily in the saw-mill business, and had become one of the nation's "lumber barons." His story, recounted by Fred Burgess for the benefit of the guest, was not without its influence on Charlie, who loved to hear a saga of success.

In the course of his two-day stay in Oshkosh, Jackson learned a great deal about Fred and Anna Burgess. To Fred he gave credit for teaching his sons the value of hard, clean-cut work, and the importance of assuming responsibility for carrying every task through to its end. To Anna he attributed a twofold influence, of mother-love and motherly ambition; always urging her boys to set high goals for themselves, she hoped and worked and prayed that they might win.

While Professor Jackson was getting acquainted with his genial host and hostess, they were confirming the favorable opinion they had already formed of him. They were pleased to know that the suggestion for the visit had come from him, and they found him to be a delightful guest, one who would always be welcome.

As we already noted, the trip to Oshkosh and back covered about 200 miles, and for most of that distance the two cyclists were able to ride leisurely, side by side, discussing many problems as they went. One problem they discussed was their plan for an *Electrical Engineering Handbook.* Jackson was under contract with the MacMillan Company to prepare such a book, and had invited Burgess to collaborate. Burgess's name was to appear on the title-page as joint author, and he was to receive one third of the royalties, which were expected to reach a substantial amount each year; perhaps as much as $2,000 for Jackson and $1,000 for Burgess. Tempting figures, these; in one of his letters Burgess described them as "fabulous." Light-heartedly they wheeled their way along, and wondered what they'd do with all that money. Pleasant thoughts made pleasant travel. Later on both men found themselves so engrossed in their immediate tasks that they could not spare time for a book, however profitable, and the plan was dropped. They'd rather make research than royalties. Burgess often planned to write books, usually in collaboration with other educators. Because such books called for high standards of accuracy, based on months or even

Engineering College Instructional Force—November 23, 1898

Top Row—C. F. Burgess, W. G. Lottes, Storm Bull, F. R. Jones, Walter Alexander, L. S. Smith
Third Row—N. O. Whitney, D. C. Jackson, Geo. C. Mors
Second Row—R. W. Hargrave, F. E. Turneaure, J. E. Davies, J. G. D. Mack, I. Mutchler
Bottom Row—C. I. King, B. V. Swenson, E. R. Maurer, M. C. Beebe

years of application, not one of them was completed. Burgess was not going to be satisfied with anything short of perfection.

One day, as he and Professor Jackson walked "up the Hill" Burgess outlined some of his ideas about making a better dry cell. Jackson promptly said "Good, if you can do that, the world will pat you on the back." Those ready words of encouragement were never to be forgotten, especially when some of the younger man's "improvements" were failures. Armed with the zeal of a researcher, he refused to be disheartened. Learning what not to do was time well spent; it cleared the way for unrestricted progress.

In 1898 the dry cell was a relatively new product. People were still inclined to regard it as a mere scientific novelty, useful, perhaps, in telephone sets or doorbells, but entirely without glamour or popular interest. 75 million Americans had never owned a dry battery; 75 million Americans were satisfied to do without. And then came Conrad Hubert.

In the closing years of the 19th Century, Conrad Hubert operated a small novelty shop in New York City. One of his novelties was a trick necktie pin, the head of which was a tiny electric lamp, "made luminous by current derived from a battery carried in the pocket." The carbon filament of this lamp was poor, the crude dry battery was poor; neither was likely to function for more than a hundred feeble flashes; hence the term flashlight. And yet the thing was not without appeal. Since the dawn of creation, the making of light has brought to mortal man a sense of creative power; that sense was now revived, absurdly, if you please, but none the less surely, in the pressing of the concealed button which made a tiepin twinkle like a very distant star. A flash in the pin; but by no means a flash in the pan for in the course of years those feeble twinklings grew stronger, and longer, and more dependable. By the summer of 1898, when Jackson and Burgess took their bicycle trip to Oshkosh, they knew that Conrad Hubert in New York was taking his flashlight out of the strictly novelty class; it had now assumed the familiar cylindrical form. The tube was of paper, with cheap metal fittings, the reflector was a concave disc of thin brass, the flash was made by pressing a spring contact switch. There was no lens. Mr. G. W. Heise has pointed out that Hubert had bought the patents on this little "torch" from its inventor, David Misell,[300] who helped him manufacture the torch and its dry battery.

A poor thing, perhaps; but a poor thing which was to grow rich. A thing, too, which added a new 100% American meaning to the word *flashlight*. In Britain the thing came to be called flash-lamp, or electric torch; Americans insisted on sticking to flashlight; yet almost half a century was to pass before flashlight in this sense was to be recorded in the principal American dictionaries. The fascinating gadget with an American name made a deep impression on the mind of Charlie Burgess; it seemed to offer further possibilities, and he wondered if those possibilities held any promise for him. It is interesting to note that in 1907—nearly ten years later—meter readers in Chicago were still using small hand

lamps powered by storage cells, and Burgess was advising them to use flashlights with handy "throw-away" dry cells instead.

In the fall of 1898, Burgess gained a new friend in the person of Arba B. Marvin, a young man who enrolled at the University as a junior and took courses in electrochemistry and related subjects. Burgess was Marvin's class officer, adviser, and guide in selecting studies. The two became close friends, and their association was to extend through many eventful years.

Shortly before the end of the year, Burgess was invited to Chicago to give a talk before a technical society on one of his favorite topics, the electrolytic cleaning of metal surfaces.[43] As was his custom, he gave the talk a very practical turn, and explained in detail how the surfaces could be cleaned of oil, grease, paint or the like. In the audience was a reporter from a Chicago newspaper, and Burgess liked to recall how the newspaper announced next day that Burgess of the University of Wisconsin had told how electricity could be used for cleaning surfaces, and how this spelled the doom of the jobs of the window-cleaners and scrub-women of Chicago. To the relief of workers concerned, their jobs were not affected; and in electroplating circles there was a feeling that Burgess seemed to know what he was talking about. O. W. Storey '10 sizes up the situation as follows:

> This talk, together with Burgess's articles on the same subject, must have focused the attention of much of the electroplating fraternity on this budding young instructor, no doubt called "professor" by those out in the shops.
>
> And this young "professor" when he did have the opportunity of going into the plating rooms and of meeting the operators, knew how to handle himself. He could talk their language, and he exchanged bites of chewing tobacco with them. They liked his pleasant personality, and he liked to hear about their families and particularly about their "kids," and sometimes he would visit their homes. Here was a different kind of "high brow," who talked their language and who quickly got their confidence. He was a "regular" fellow.

Burgess's 1898 talk in Chicago brought far-reaching results. He described it later as "the beginning of the electrolytic cleaning practice which has now become a standard operation in the cleaning of metal surfaces," and, he added, "Out of this fact I derived for myself a keen enjoyment." Then, in answer to a natural question, he said:

> I did try to patent the idea, but found that Edison had antedated me by many years. I had an opportunity later of taking him to task for defeating me in my youthful ambitions. He laughed and said, "That was the fate of many of *my* inventions. It was patented at the time that electricity was a scarce and costly commodity, and by the time that electricity was abundant the patent had expired."

Burgess went on to say that he believed both Edison and himself had a lot of fun in thinking that they had discovered a phenomenon that would be useful, even though they received no financial rewards.

Before bidding farewell to 1898, we may well recall the historic fact that in this year Pierre and Marie Curie discovered radium. When the news reached Madison, Burgess—as if he hadn't enough irons in the fire—began to make plans for obtaining samples of pitchblende, from which he might extract at least a small sample of the fascinating new element. None seemed to be available at the moment, and the project was dropped. Luckily for him, Burgess was destined to stay clear of radium.

7.

Instructor and Assistant Professor 1899-1900

IN 1899, brand-new bicycles were advertised in the United States at prices ranging all the way from $19.00 to $125.00; for the latter figure one might possess "A Bicycle Built for Two," and enjoy the bliss described in that immortal song of the Nineties, "Daisy Bell." The nation's annual sales had reached well over a million machines, manufactured largely in the East and the Middle West, and representing the output of more than 300 competing plants, many of them less than three years old. A bicycle was easy to sell—the demand was greater than the supply; a bicycle was easy to make—its framework was little else than half a dozen steel tubes, neatly brazed together by a brass composition which in the shops is called spelter.

We have already learned that Burgess rode a bicycle, but perhaps we have not realized how, in the words of one of his friends, "he rode a bicycle to fame in the electrochemical industry." In that statement there is as much truth as poetry. Many bicycle parts had to be nickel-plated; surplus brass had to be removed from the frames; metal surfaces had to be cleaned. Burgess showed the trade how to do all three things more efficiently.

In 1897, Burgess, well versed in the *theory* of the electroplating art, had begun to meet professional electroplaters. One of these was Allan G. Park, of Madison, who, among other activities, worked on bicycles made by D. D. Warner Co. of the same city. Burgess and Allan Park made a good team; each respected the other's talents. Park was glad to learn from a "professor"; Burgess was eager to get co-operation from a man in the trade. Allan Park often built special equipment for Burgess, but in the Nineties their dealings were mainly concerned with work on bicycle frames and parts. Park's shop was the scene of many tests of new methods of plating, and of cleaning metal surfaces for plating.

The problem of surplus brass was put up to Burgess by his friend Murray C. Beebe, then an instructor in the University. Home in Racine for the Christmas 1898 vacation, Beebe visited a bicycle plant with which his father was connected. There he was shown the need for an improved method of removing the surplus brass which adhered to the bicycle frames. It was the custom to do this by filing or grinding, which was slow and expensive. How to discover a better debrassing method was one of the in-

dustry's major problems. On December 29 Beebe wrote to Burgess suggesting that some electrolytic method might be devised to remove the brass, "and leave the iron underneath clean, so that enamel will stick." He added, "You can think it over if you care to, and if we do anything we want to do it quick."

Before the end of January 1899, Burgess had solved the problem by electrochemical means.[48, 49] In the process adopted, the spelter was removed by suspending the bicycle frame in a dilute sodium nitrate solution, the frame itself being the anode. Then, as Burgess explained, "using a fairly high current density, which takes a voltage of from seven to ten volts, the brass is removed in a few minutes, leaving a bright white steel." Care had to be taken to remove the frame from the bath at the right moment, so that the action might not continue into the joint itself. It was noted that the saving would amount to nearly 25c on each frame, which, in view of the fact that even a small plant might turn out 500 bicycles a day, added up to real money.

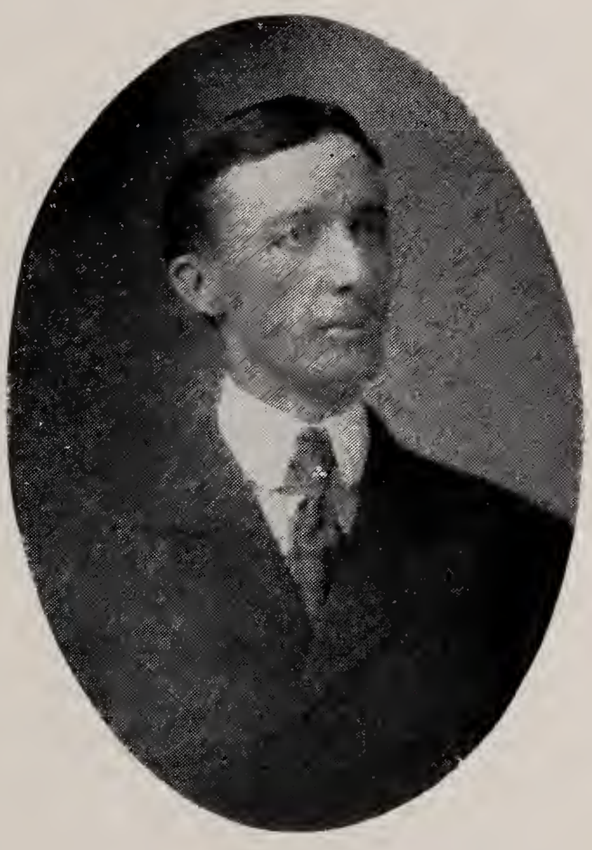
In February 1899 Burgess filed a patent application, listed as Serial No. 707,395, "Method for the Removal of Superfluous Metal." Then he went boldly ahead on the "Patent pending" basis and granted licenses to a number of manufacturers to use the method on a royalty proposition. They were pledged to treat it strictly as a secret process. Such a plan was feasible at the turn of the century, when few business men had a knowledge of chemistry, and few industries maintained research departments. Once assured that the process would work, the licensees were content to pay their royalties, and to buy all their "blue salt" from Burgess. They did not know that they were buying Chile saltpeter, disguised by the addition of a small quantity of blue coloring material. They did know that it cost them only eight cents a pound, and that it always worked without a hitch. Well, almost always; for on one occasion, when Burgess shipped some saltpeter uncolored because he was too busy to dye it, it promptly came back with the message, "This white salt won't work. What we need is the blue kind, as usual." Such is the power of mind over matter.

To promote the sale of the new process, Burgess employed his ingenious friend Allan G. Park, who called on bicycle manufacturers all over the eastern half of the United States. This was early in 1899. Recalling the good work done at this time, Burgess said, "Al Park was my first traveling salesman, and ranked with the best."

On more than one occasion, Beebe was absent from his university duties while he visited various cities to maintain contact with users or prospective users of the debrassing process. During such absences, Burgess undertook the teaching of Beebe's classes. In time both men realized that running a business of this type "on the side" was very burdensome. Sometimes they found it difficult to collect the royalties due them after their initial charge of $200 to $400 per installation. When Beebe left the University in 1899 to work in Pittsburgh, the entire business was turned over to the Hanson & Van Winkle Co., under an arrangement by which Burgess and Beebe continued to receive royalties.

In June 1901, learning that the Patent Office had found that his proc-

C. F. Burgess about 1900



C. F. Burgess
(Taken in Rumford Falls, Maine, 1907)

ess was described in an earlier publication, Burgess abandoned his patent application, and by the end of the year, income from the debrassing business, which had been shared equally between Burgess and Beebe, came to an end. Taken altogether, this venture—Burgess's first real business enterprise—had not been unprofitable. Only a few hundred dollars a year had come in, but Burgess had gained valuable experience, in electrochemistry, in patent-office procedure, and in dealing with licensees; and there is some basis for the fanciful statement that thousands of Americans rode millions of miles astride bicycle frames made smoother by the art of C. F. Burgess.

Something happened in the spring of 1899 which was to bring unexpected publicity to Burgess, both locally and outside of Madison. Part of the story can be quoted from a letter which he wrote forty years later:

> It was in 1899. A winter month when the central Northwest was visited by an unprecedented cold spell; where for weeks the temperature had been below zero. The frost had penetrated deeper and deeper into the ground, and the water pipes, even where buried from eight to ten feet, were frozen. It was a calamity indeed, for a water famine prevailed.
>
> Coming to our boarding house on a winter day, I saw a large group of people had gathered before the house of Lawyer Brown, at the corner of Langdon and Francis Streets. Joining the curious observers, I saw Professor Jackson and Professor Wood working with a transformer and other equipment which I recognized as coming from the electrical laboratory. The high tension side of the transformer was connected to the electric power circuit; the low tension side being connected through a resistance to the frozen water pipe, one end to the hydrant and the other to a service faucet in Mr. Brown's residence.
>
> It was not long before a trickle of water came from the frozen faucet, and not much longer before a full-sized stream was flowing. A cheer went up, as the water famine was broken.
>
> It was a public service; a water famine in the Northwest had been averted by a simple electrical process, which has now become standard practice.

What Burgess saw on that cold day must have heated him up considerably when he recalled a recent conversation with Professor B. W. Snow of the Physics Department, in which department Wood also was a professor. Upon returning to his office he promptly noted in writing that on Wednesday, February 15, 1899, he had had a conversation with Professor B. W. Snow, who was having trouble thawing out his water pipes. Then, in a form suitable for proving priority in a patent contest (a patent application was not filed, however), writes Burgess:

> I suggested to him at that time that these pipes could be thawed out without digging up the street by connecing the pipe to a dynamo and passing a current through the pipe. Upon his suggestion that the current would leak through the earth, I said that frozen earth would conduct very little of the current.

On the same day, in a conversation with Professor Dugald C. Jackson, Burgess pointed out that where it was not possible to use

current from the electric lighting system it should be possible to use "a portable steam-engine for driving a dynamo to furnish the required current."

Although Jackson and Wood innocently enough were the first to demonstrate the electric thawing of frozen water pipes as suggested by Burgess, nevertheless his fame as the pioneer electrical defroster soon spread far and wide. Within a few weeks word came from a friend in Mexico that a newspaper in that country had announced that Professor Burgess, of the University of Wisconsin, "had successfully applied electricity to frozen pipes." The method attracted so much attention that the regents permitted the University to co-operate in its development and application to Madison;* and in February 1904 Burgess wrote to his father that the process was being worked commercially and that "the Madison Gas & Electric Co. are thawing them out at $7 per thaw."

On Friday May 5, 1899, Burgess became a charter member of the Alpha of Wisconsin chapter of Tau Beta Pi, honorary engineering fraternity, which chapter was installed on the same day. The ceremonies were held at the Hotel Van Etta, on King Street, Madison, and Burgess was one of the principal speakers. Active in bringing the Tau Beta Pi to Wisconsin was Professor Bernard V. Swenson, who had belonged to the organization while at the University of Illinois. Arrangements for electing the student members and for the initiation were largely in the hands of Burgess, aided by Murray C. Beebe and by Walter Alexander '97. Other charter members included Arba B. Marvin '00 and Carl Hambuechen '99.

All in all, the year 1899 was kind to Burgess; his work was prospering and his circle of worth-while friends was growing. For the most part they were masculine friends, all right as far as they went; but was it far enough? Writing to his old friend Fortenbaugh, Charlie continued to have no news about any summer girl, still less about a downright better half. This state of affairs, to his logical way of thinking, was not quite right. He rejoiced in October when his brother George up and married Harriet Painter Van Trump; but he couldn't help reflecting that George had stolen a march on him; after all, George was a year and a half younger.

Reflections such as these often passed through his mind, and as often were lost in the busy routine of university life. Busy it surely was, and sometimes it brought unexpected duties. One of these, a sad duty, was entrusted to Burgess early in 1900, after the death of his good friend, Professor John E. Davies; in the name of the Science Club he wrote a letter of condolence to the widow of the man who had been his first professor of electricity. In typing the letter his stenographer made it appear that the

*During the printing of this book, Mr. O. W. Storey made a valuable comment, as follows: "The electric-thawing story as gathered from Burgess's records is somewhat at variance with that told in Curti and Carstensen's *History of the University of Wisconsin* Vol. II, pp. 459-460 (University of Wisconsin Press 1949), based on newspaper reports at the time. Curti and Carstensen also point out the importance of this incident to the University, how President Adams of the University used it to justify expenditures for higher education, and how it redounded to the benefit of the engineering college with the suggestion that it 'lost no support' among legislators for an appropriation for a new engineering building, funds for which were voted shortly thereafter."

Club's resolution of condolence was passed by a rising "volt." Perhaps the widow smiled through her tears, and wished she could share the unintended joke with one who would have loved it. Professor Davies would surely have been interested in something else which was happening early in 1900. Under Burgess's guidance, Albert A. Radtke '00, an electrical engineering student, was testing dry cells of a dozen different makes then on the market. This was the first of an important series of tests sponsored by Burgess in the years that followed. The 1900 tests were incorporated in a thesis written by Radtke.[240]

In mid-April, 1900, the regents met again. This time they voted "That the title of Charles F. Burgess be made that of Assistant Professor in Electrical Engineering"; they also granted him a $200 increase in salary. This was good news indeed, and Charlie Burgess hastened to share it with his mother. In the letter which he wrote her he added "Mrs. Jackson gave a swell dinner in honor of my promotion to a professorship."

Rejoicing with Burgess, Dugald C. Jackson had reason to be gratified with his own progress at Wisconsin. His Electrical Engineering Department had now, in the words of the historian Reuben Gold Thwaites, "become the largest of the three comprising the College of Mechanics and Engineering," and this in less than ten years from its start. At the "swell dinner" for Burgess, Charlie added to his words of thanks a sincere note of tribute; perhaps better than anyone else he realized that Professor Jackson's unquestioned success was based on unremitting hard work.

Another happening in June 1900 was the graduation of Arba B. Marvin, with a Bachelor of Science degree in Electrical Engineering. Marvin now went to Schenectady to work for General Electric. Burgess, still dreaming of industrial developments, congratulated his friend, and was inclined to envy him. A few months later, writing to his old classmate, George A. Mead, chief engineer of a Cleveland firm, Burgess said, "Yes, I am still at it, trying to teach the young to shoot. . . . I don't know how much longer I shall keep at it, but probably not a great while, as I am expecting to get into commercial work."

Note that he does not say "hoping"; he says "expecting," as though the move he has in mind is a definite one. That it was reasonably definite we learn from a letter to his mother, dated April 22, 1900. It seems that he has been considering an offer of lucrative employment in England. Fortenbaugh, working for one of the leading electrical concerns of Great Britain, has offered him a job there at $1500 a year. But now he assures his mother that he has abandoned the idea of going abroad, because he has what appears to be a better opportunity in Madison. Outlining this opportunity, he adds:

> I was asked by some of the leading business men of this city to go into a manufacturing business along the lines of electrochemistry, they to furnish the capital and business experience, and I the engineering experience. They propose to establish a laboratory for experimental work, and to put in as much capital as would be warranted. The plan is for me to retain my connection with the University if I can be relieved of a large part of my work by turning it over to an assistant, and I will

> devote the remainder of my time to the business. My salary, which would be guaranteed, would amount to more than I am getting, with the possibility of making considerably more as a share of profits. . . . There is every prospect of the scheme going through and being made public before long.

In December, more than eight months later, Burgess added his signature to a four-page document, revealing that the "leading business men" were F. A. Johnson, H. S. Johnson, C. A. Johnson and M. I. Johnson, of the Gisholt Machine Company. The agreement, made between the four Johnsons, parties of the first part, and Charles F. Burgess, party of the second part, was far-reaching in its scope. It involved organization of:

> . . . a joint stock company for the purpose of manufacturing and dealing in chemical machinery and appliances, electrical machinery and appliances of all kinds; also for the purpose of introducing, installing and operating chemical and electrochemical processes in this and foreign countries, and also to do a general engineering business along electrical and chemical lines; further, to acquire real estate and personal property to be used in connection with the above; and also to buy and sell patent rights relating to the above processes. . .

As the arrangement had really gone into force in July, the signing of this agreement on December 31, 1900—last day of the last month of the Nineteenth Century—may have been a touch of Burgessian symbolism. "Ring out the old," it seemed to say—"Ring in the new"; and let it be a century of freedom. Freedom at last from academic bonds; freedom to enter the era so long idealized—the era generously devoted to industrial research and development.

8.

Assistant Professor at Wisconsin 1901

THE four Johnsons had no hesitation in backing Burgess in what might have seemed a highly speculative venture, because they knew of his record of accomplishment in teaching, in inventiveness, and in contact with industrial leaders. As one of his friends has pointed out:

> He had developed and proved new processes and equipment on which he applied for patents and which probably could be developed further and commercialized on a large scale both at home and abroad.
>
> These developments included the capillary electrometer, electrolytic cleaning of metals, and debrassing. He was working on other electrolytic processes and had worked out methods for making lead compounds. His development work was not limited to electrochemical lines, but he was also developing electrical devices (as evidenced by patents granted to him shortly thereafter).

However, as the first months of the new century came and passed, Burgess began to realize that the contract he and his friends had signed in the closing hours of 1900 was hardly more than a declaration of intention. Before the proposed company could be organized and put to work, a great deal of time would have to be spent in the study of details, definite progress on several promising inventions would have to be made, and a suitable man would have to be found to relieve Burgess of some of his work as an instructor. Plans and discussions did go on through many months, but Burgess was not unduly impatient. He liked making plans, and meanwhile there was plenty of interesting work to do at the University, both in teaching and research.

One of Burgess's principal aids—a student who could assist him at the University and help also in the work of the proposed new company—was Carl Hambuechen. Hambuechen, of the class of 1899, had won his B. S. in Electrical Engineering, graduating with honors. Then he had spent a year in practical work, as an inspector with the Western Electric Company in Chicago. Only 25 years old, he was making a name for himself in chemical and electrochemical research. Burgess now had him working on an invention for converting alternating into direct current. The device, consisting substantially of aluminum and iron plates placed in a bath of fused sodium nitrate, was called an electrolytic recti-

fier. Light in weight and simple in construction it offered a means of converting current very efficiently and cheaply. On April 12, 1901, Burgess signed a contract with Hambuechen, in which the two agreed to share equally all work, expenses and profit on the invention. In addition to Hambuechen's regular studies, and his research on the rectifier, he was now in charge of Burgess's laboratory work, and assisting in the teaching of Burgess's students; and at the June 1901 Commencement he received his advanced degree of Electrical Engineer. His thesis was entitled "The Aluminum Cell as a Rectifier of Alternating Currents."[257] It may be mentioned that the molten electrolyte used in the rectifier was Hambuechen's discovery.[235] Part of Hambuechen's 1901 income came from the Johnsons, who paid for work he was doing under Burgess's contract with them. They paid Burgess $166.00 a month; this shows why he had not accepted Fortenbaugh's offer to go to England for $1500 a year.

Burgess himself continued to be very busy; it would be wrong to say "unusually" busy, for his cup of activities was full to the brim, and sometimes running over, throughout the year. But no matter how many duties piled up, time was always found for writing a paper, or addressing a letter to the scientific press. On May 7th, for example, Burgess wrote to the *Electrical World,*[68] inveighing against certain European theories of study and education, and against their adoption in the technical schools of the United States. As always, he stressed the importance of questioning the soundness of all theories, even those uttered by the almost deified German chemists. Louis Kahlenberg had shown that some of these theories were questionable because of exceptions that could not be explained by them; and Burgess in his letter now strikes a note of independence:

> Why is it that technical electrochemistry has made more rapid progress here than abroad, in spite of the fact that there is a scarcity of electrochemists in our own country trained in the German schools? There is no reason other than that electrochemical phenomena which have long been known have been taken up by our progressive engineers, and through their efforts the former laboratory experiments have been enlarged into industrial processes.

Further stressing the need for a practical concept of education, Burgess adds:

> The technical graduate who is best equipped for entering into this promising field of applied electrochemistry must have an *engineering* training, and a very broad one at that, which will enable him to repeat on an industrial scale experiments which were performed as far back as the Faraday-Berthelot school. The owners of electrochemical industries are not advertising for men to determine the dissociation constants at extreme dilution, or to measure solution tensions and osmotic pressures under ideal conditions, or to determine the velocity of migration of ions; but, rather, men who can operate machinery, and design and work electrolytic appliances so that a kilowatt hour may be made to do the greatest service.

Burgess had very definite views on methods of teaching, and he never

hesitated to express them. During his entire teaching career at Wisconsin, and even afterwards, he was engaged in controversy involving subjects to be taught and how to teach them. Some of his differences were with the general educational policies of the University, some of them were with individual teachers; among the latter may be mentioned his friend and colleague, Louis Kahlenberg. It goes without saying that Burgess, though never ceasing to be an idealist, took the practical, utilitarian side of the argument.

In 1901, after a bitterly fought campaign, the people of Wisconsin elected as their governor a progressive-minded young man who had been born in a log cabin on a farm not far from Madison; his name was Robert M. LaFollette. Born in a rural township known as Primrose, LaFollette never trod the primrose path. He was a fighter from the word "go," and his political career was a series of struggles, sometimes for great reforms, sometimes for small.

One of LaFollette's greater reforms was based on his belief that "women should play a larger part in the greater housekeeping of the state." His wife, Belle Case LaFollette '79, was the first woman graduated from the Wisconsin University Law School, and she had been of incalculable help to him. LaFollette never underestimated the power of a woman, and in his initial message to the Legislature he recommended the appointment of the first woman ever to serve on the University's Board of Regents. She was Dr. Almah J. Frisby '78, a practicing physician of Milwaukee. As State Inspector of Factories he recommended Ida May Jackson, already mentioned as a reporter on Milwaukee newspapers. He made this appointment because Miss Jackson was, in his own words, "a bright young woman, who through her newspaper experience had become interested in social questions, and well prepared for the service." Later on several other women were given public office in Wisconsin. Dr. Frisby's appointment was hailed in the press as a sensible move. She was a woman of high ability, and had served the University for several years as a professor. Comment on some of the other choices varied from factual to facetious. Concerning Miss Jackson, the *Milwaukee Sentinel* was content to say, some time in July 1901:

> Halford Erickson, labor commissioner, has just announced the appointment of Miss Ida May Jackson, of Milwaukee, as Woman Factory Inspector. Under the law creating the position, the salary is $1,000, but the commissioner will have Miss Jackson do some extra work which will probably enable her to draw $1200 or $1300 a year.

An editorial in the *Waupun Times,* also about July 1901, provides a good example of the quaint humor of the period:

> The editor of the Sauk County Democrat, the president of, and handsomest man in, the state press, rises to remark that all Wisconsin newspaper offices should now come under the head of factories. Which is apropos of Miss Jackson's appointment as factory inspector. And all of his esteemed contemporaries doubtless think "Them air's my sentiments tew."

Without benefit of a press agent, Ida May Jackson achieved a measure of fame. The "female factory inspector" was a real novelty, and the story of her appointment was printed and reprinted throughout the land. And if that statement seems a mild exaggeration, we can prove that it spread at least as far as Arkansas. On July 30, 1901, an eccentric, elderly man in DeWitt, Arkansas, sat himself down and carefully penned a long, soulful letter to "Miss Ida M. Jackson, Factory Inspector, Milwaukee, Wis." It was a virtual offer of marriage. It was gently turned down; for Ida May had duties to perform; and she took up her work with becoming zest and vigor. In November 1901 she was quoted in the press as saying, "I have police power, and wear a star." Clearly this man La Follette had started something.

One of LaFollette's other reforms had to do with the illuminating property of oils. He had noticed that oil lamps used in country homes, and oil lanterns carried into barns, were often very poor at giving light, and he suspected that the general dimness might be blamed on the sale of inferior grades of kerosene. Here was a wrong that seemed to call for righting; and the men best fitted to right it would surely be found at the state university. So turning to his Alma Mater, Robert M. LaFollette, of the Class of '79, appointed an Illuminating Oil Commission of three experts, Professors Benjamin W. Snow, Bernard V. Swenson and Charles F. Burgess. All three were glad to serve, particularly Burgess, who hailed LaFollette as "that great champion of the masses who believed that the benefits of science should be made available to the common people."

Burgess was mildly surprised that anyone should select him as an "oil expert." But he was willing to be an expert on anything under the sun; and he knew how to set about it. The way to become an expert in oil or anything else was to start as though he knew nothing about it, and build his information step by step. In solving the present problem a man who knew "all about oil" would be handicapped by preconceived notions. Without such obstacles the way was clear; it was the way of research. So Burgess and his colleagues went to work. Years later he described their research and its unexpected result.[33]

> Governor LaFollette decided that oil inspectors should be appointed; they were to be equipped with photometric instruments and instructed to see that all kerosene sold in Wisconsin should conform to suitable standards.
>
> Legislation was passed to bring this about. A committee of scientists and engineers, three in number of which I was one, was appointed to define candle power standards for kerosene and design the equipment to be carried by the inspectors.
>
> After collecting a large variety of burners and many samples of kerosene sold by dealers throughout the state, we made careful photometric tests. To our consternation, these revealed the fact that all the grades of kerosene gave identical candle power values; the differences in illumination from the lamps and lanterns were found to be dependent upon the care and frequency with which wicks were trimmed and the chimneys cleaned.
>
> The committee was then discharged, and the people were left to their own devices.

Governor LaFollette was a bit disgusted. A campaign which had seemed to have excellent political possibilities had turned out to be a flop. But Burgess was not discouraged; the results of the investigation *had* been somewhat disappointing, but they were true. By calling attention to the real causes of the trouble—untrimmed wicks and unclean chimneys—the experts had gone far towards realizing the Governor's main ideal—to keep Wisconsin's oil lamps burning brighter.

Soon after Commencement, the practical Burgess was on his way to Buffalo to spend a few days at the Pan American Exposition. As might be expected, he put in most of his time at the buildings devoted to machinery and electricity. Doubtless these buildings contained some marvels which had not been seen eight years earlier at the Chicago World's Fair; but this time hardly anything seemed new. Even if Burgess had not seen the few novelties before, he had read about them in his technical journals. Maybe he compared them unfavorably with some of his own developments, original in concept and rich in promise of reward. He wrote to his mother, "The exposition was not very remarkable, and I would not urge you to go." But perhaps after all the trip was worth while, for, he added, "I enjoyed the meeting of the Electrical Association, and making the acquaintance of prominent engineers." This probably refers to The American Institute of Electrical Engineers, which met in Buffalo during the Exposition. One of the prominent engineers was Professor Henry S. Carhart, of *Primary Batteries* fame, who had come on from the University of Michigan. Burgess was especially glad to meet the author of his best-remembered textbook. A few months later, on November 29th, he became a member of The American Chemical Society, and his circle of acquaintance in learned groups was again enlarged.

September 5th brought a noted visitor to the Pan American Exposition, in the person of President William McKinley. The President addressed a large audience on "The Prosperity of the Country," and he spoke at some length on the uses of expositions, which, he said, "are timekeepers of progress. They record the world's advancement. They stimulate the energy, enterprise and intellect of the people, and quicken human genius. They open mighty storehouses of information to the student." Next day, attending a reception at the exposition's Temple of Music, Mr. McKinley was shot by an assassin, and on September 14th he died. Thus Theodore Roosevelt, who had been pushed into the vice-presidency "to keep him out of politics," became President of the United States. Wisconsin had just elected a young man for governor, and now the hand of fate had given the nation its youngest president. Was this to be a century of youth?

On September 25th, when the 1901-1902 semester opened, Arba B. Marvin reappeared. Since his graduation in June 1900, Marvin had worked in Schenectady. Now, at the invitation of Professor Burgess, he returned to do graduate work and to serve as Laboratory Assistant in Electrochemistry.

One day in 1901, Charlie Burgess received a letter from his old classmate George A. Mead, the main topic of which was "wives." Mead was in favor of them; he had made his choice, and felt it was high time

for Burgess to follow his example. He said something about Burgess being 28 years old. Thinking the matter over, Charlie probably recalled the example of his father, who had not married till 39. Anyhow, he replied to Mead that he *might* look for a wife, after thinking about it for another eight or ten years! So once again romance was pushed aside.

9.

Courtship and Marriage 1902-1903

BURGESS'S thirtieth birthday, January 5, 1902, started him on a busy and eventful year. In 1902 he became a charter member of the American Electrochemical Society; in 1902 he began working on the problem of producing pure iron by electrochemical means; in 1902 he discovered that he would *not* have to wait "another eight or ten years" before finding himself a wife. Biographically speaking, these and other developments conspire to change the form of his life-story. The simple year-by-year narrative is interrupted by excursions into many fields of study and enterprise. Some of these excursions, impatient of the limits of the calendar, would seem to claim full chapters for themselves; especially those in which the study of one topic extends through a number of years.

A few happenings, however, belong definitely to 1902. It was in this year that Burgess for the second time lost his friend and laboratory assistant, Arba B. Marvin. After only about nine months in Madison, Marvin went to Washington, D. C., where he expected to take graduate work in physics, but—as he later explained—"got diverted to law, and went into the Patent Office as an examiner." In 1902, *Popular Mechanics* pleased Burgess and Hambuechen with a story in its issue of December 20 praising the electrolytic rectifier, stating "it will be a great saving in the cost of charging automobiles." In the same year, Burgess read a book by a scientist who was later to be one of his friends; the book was *Metallurgical Laboratory Notes,* its author was Henry Marion Howe, famed authority on iron and steel, son of Julia Ward Howe. Late in October came word of the death of Sidney H. Short, man of genius and success, at the early age of 44. Mr. Short died in London, after establishing plants there and in Paris. In one brief summer in Cleveland, seven years earlier, he had made a deep and lasting impression on Burgess.

But the person who made the greatest impression on Burgess in 1902 was a factory inspector. Burgess possessed nothing that looked like a factory, but that didn't seem to bother the inspector, who, it should be explained, was our friend of Chapters 2 and 8, Ida May Jackson. Charles met Ida through a mutual friend, Miss Marion Lamont; tradition places their first meeting at Mrs. Ogilvie's boarding house, on Langdon Street. Burgess was living with two other bachelors, Charles Sullivan and Canby Nicodemus, in a little yellow house at the turn of Langdon, across from Mrs. Ogilvie's. Ida never forgot what happened. One day, when she

Ida May Jackson (Mrs. C. F. Burgess) as factory inspector in 1901

was sitting on the front porch, a dashing young man came up the steps and said, "I have come to take you out tonight." Ida looked him over and said, "You are very fresh." But she went with him.

One reminiscing neighbor describes the courtship as having been strenuous; another deposes that while Charlie had never been indifferent to feminine charm, Ida was the first girl to whom he paid "serious" attention; a third quotes him as saying to Canby Nicodemus, "This is the first girl I ever met that I could look up to intellectually"; to which fellow-bachelor Nicodemus is said to have retorted, "Humph! I wouldn't want to look up to my wife—always." But Charlie was content to have it so, and Ida was very willing to be a professor's wife. So, on Thursday June 25, 1903, they were married. The wedding ceremony took place in a house on the side of a hill, the old Tenney residence in Madison, built by Ida's grandfather in 1856. Ida's mother had been married in a corner of the parlor; Ida was married in the same corner. After a short wedding trip, Charles and Ida spent the rest of their honeymoon at the home of their friends the John M. Parkinsons, Mendota Court, Madison, the Parkinsons thoughtfully going off on a vacation.

From the honeymoon quarters they moved into an apartment on West Gilman Street, and bravely tried to prove the quaint old theory that two can live cheaper than one. In their case it was not too easy. For reasons more or less unavoidable, the contract arrangement with the Johnsons showed signs of coming to an end, and prospects of substantial additions to Burgess's income faded. The professor tried to face the situation as just one more problem to be solved, a problem not in chemistry or engineering, but in economics. Some months before their first Anniversary he spoke up. "Ida," he said, "if you'll tell me what we need to live on, I'll go and get it." Ida named an amount, and—so the story goes—Charles got it. No mystery is attached to the "getting" of this extra money; it came in the form of relatively small consulting fees, payments for the writing of technical articles and book reviews, and proceeds of occasional sales of special electrical equipment developed by Burgess. As one means of securing outside work, a business card was inserted in *Electrochemical Industry*: "Burgess, C. F., E.E., Electrochemical Engineer. Experimental investigations, laboratory tests, processes developed." His address was given as Engineering Building, University of Wisconsin. In some transactions he had the help of Carl Hambuechen; certain papers of this period are marked with a rubber stamp: "Burgess & Hambuechen, Electrochemical Laboratory, Madison, Wis." If the Johnson arrangement were to fall through, there might not be enough work to give Hambuechen a satisfactory income, in which case Burgess was likely to lose the aid of a valued colleague.

"Never a dull moment" might well serve as title for the married life of Charles and Ida. Friends of the dynamic young scientist, whose nervous drive, they said, "sometimes verged on irascibility," were in the habit of adding, "He has married a very understanding woman." That was all right with Ida; she did understand him; and understanding, she loved. When occasions for disagreement arose, Charles thought up a whimsically unscientific way of meeting them. Soon after they set up

Ida May Jackson (Mrs. C. F. Burgess) at about the time of her marriage in 1903

housekeeping, he brought home a little package. Opening it, he produced, and placed on the mantel, a dice-box. Ida said, "Why?" Charles, in his best professorial style, replied, "There will be times when you and I will disagree. We will shake the dice. The loser will give in to the other. That will decide all controversial questions that might otherwise lead to irritation." For years that dice-box occupied the mantel, a symbol of resolve to live in peace.

Describing the routine of the Burgess household in those early days, a neighbor recalls that "Ida and her husband each had their own circle of friends, as well as those they knew together." The third group naturally included the University set. Professor Kahlenberg used to drop in, and Carl Hambuechen; a young geologist named William O. Hotchkiss; an older man, Oliver P. Watts, who came with his wife from Massachusetts to study electrochemistry under Burgess. And, of course, Burgess's hero, and to a great extent his model, Professor Dugald C. Jackson, who with his wife had done so much to make the younger man's early years in Madison pleasant and profitable. These and many others, including not a few of Burgess's students, found their way to the apartment on West Gilman, and Ida proved herself to be a very satisfactory hostess. Although she was, in her own words, "rich in theories of domestic life," she had little firsthand acquaintance with housekeeping, and hardly any experience as a needlewoman. During her years of newspaper reporting she had cared for her clothes by sending them to a tailor for mending, with the comment, "If I'm going to work like a man, I'll live like a man." Marriage changed all this; and one of her friends recalls an incident, soon after Ida was married, "when she triumphantly displayed her first piece of sewing—a dress made of dotted Swiss which cost 15 cents a yard."

Ida was proud of her husband's good looks and of his generally smart appearance. But sometimes, just like a man, he would disappoint her by appearing in comfortable old clothes when he should have been in his Sunday best. Or else, more like a boy than a man, he would forget to do some needful clearing up. One evening, soon after the wedding, Ida gave her first dinner-party, to a select group of faculty members. The Burgess apartment possessed only one bedroom, which had been put into extra-apple-pie order, as a place for the honored guests to deposit their hats and overcoats. The dinner went off beautifully; everything according to schedule; the faculty members were enchanted; Ida was pleased and proud. But after the last goodnights had been said, she went into the bedroom, and found that when Charles had prepared for the party, he had stepped out of his old trousers, and left them in the middle of the floor, there to remain for all the guests to see. Ida sighed, and wondered if she had married an absent-minded professor. She soon had reason to wonder again; this time Charles had an appointment to go riding with his friend Vroman Mason. He disappeared into the bedroom to change into his riding clothes. Then—he put on his pajamas and got ready for bed. And so was born another anecdote.

Ida took a real interest in her husband's professional progress, and although she could not keep in touch with all its scientific and technical

details, she was definitely aware of some of them. She heard a good deal about the new electric furnace which claimed so much of Charles's attention in the months just preceding their marriage. One day he brought home a gift for her, a hat-pin with an unusual head that looked strangely like a bit of iridescent coal. It wasn't coal; it was carborundum. Forty years later, Ida gave it to her daughter-in-law, with a little note attached: "Charles made this in his electrical furnace in 1903. Used the hat-pin for years." Eagerly made, proudly worn, carefully preserved, symbol of true partnership through all the years of the professor's love-story, the strangely fashioned hat-pin still remains.

10.

Burgess and the American Electrochemical Society

APRIL 3, 1902, was a red-letter day in Burgess's career; it was the day when he reached Philadelphia for the first meeting of the American Electrochemical Society, which later became The Electrochemical Society. From his point of view this was an ideal gathering, because, as he said later, "it was a means of becoming on close, even intimate, terms with noted men and with young men who were to become noted"; and they were all interested in a field in which Burgess was making a name for himself; for although his title at Wisconsin was Assistant Professor in Electrical Engineering, it must be remembered that his specialty at the time was Applied Electrochemistry.

At a meeting of this kind he could learn much, but he could also teach. As it turned out, he could teach even the first president of the society, Professor Joseph W. Richards. Professor Richards, then of Lehigh University, was about nine years older than Burgess. A noted metallurgist, he was scheduled on April 4 to present the first paper on the program; it was entitled "A University Course in Electrochemistry."[307] Hardly any topic could have been more interesting to Burgess; his work for over six years had made him an expert in the building of electrochemical courses, and he sat back to listen to the speaker with close and searching attention.

When Professor Richards sat down, representatives of several universities discussed his paper, and Burgess, after sketching the progress made at Wisconsin, said that "the course we now have is very similar to that which Professor Richards has outlined. We, however, did not devote as much time to metallurgy." Then he continued:

> The principal difficulty in designing a course for electrochemical engineers, and one which it seems to me *is not overcome in the outline given in the paper just read,* is getting all the essential studies in the four years and treating them as thoroughly as they should be treated. A great deal of work, in fact, the majority of the work, has necessarily to be done in the laboratory, and with even fewer studies than indicated, the time of the student is thoroughly taken up.
>
> It seems to me that in talking on this question we must first decide whether the product is to be an electrochemical engineer, or an electrochemist. The same distinction must be drawn here as is drawn in the training of the chemist and chemi-

> cal engineer. An electrochemical engineer must be, primarily, an engineer, and it seems to me his training should be acquired by taking an engineering course. That is the object we have had in view—to make the student primarily an engineer with training in such lines of chemistry and electrochemistry as will enable him to use the combined knowledge to the best advantage.

Such words from Burgess, in the years to come, were to be heard time and again. His fellow members would never be allowed to forget his belief that the man best qualified to put their theories to work would be, at least in part, an engineer.

Later on the same day, Friday April 4, it was Burgess's turn to read a paper. This paper, in which he shared authorship with Carl Hambuechen, was entitled "The Electrolytic Rectifier."[53] It was well received, and was discussed by several notables, including President Richards. In the closing words of the paper a note of caution appears: "We deem it inadvisable to present at this time the arrangements and devices for accomplishing similar results, on account of protection which is expected from the Patent Office." Unfortunately the "expected" protection had not been applied for. Although the invention had been conceived in 1899, and reduced to practice in 1901, Burgess did not file a patent application until 1903. The consequences of this delay are described in Chapter 14.

On April 5, President Richards was scheduled to present another paper, on "Electrolysis by an Alternating Current." Burgess was well acquainted with this subject, and had done some intensive studying to prepare himself for discussion of the paper, should opportunity offer. Opportunity surely did offer. Professor Richards illustrated his talk by performing certain experiments, in each case predicting what would happen. When one of the experiments did not produce the promised result, Professor Richards was at a loss. Not so Professor Burgess. He promptly rose, and explained in detail what was wrong. Failure to produce the right effect had been due to failure to employ the right cause; to get the desired result you should do so and so; it was as simple as that.

The correction was given, and accepted, with every gesture of courtesy. But some of the electrochemists couldn't help wondering just why the young man from Wisconsin had seemed so uncannily confident, almost eager, with an explanation which plainly "showed up" the famous speaker. Years later, after a long period of friendship and close cooperation with Professor Richards, Burgess explained. Though he enjoyed every minute of his stay in Philadelphia, he had come there with a slight chip on his shoulder. Things hadn't gone exactly right. Back in October a letter had been written, inviting him to meet with about thirty noted engineers, chemists and scientists to consider founding the new society. Somehow or other, he hadn't seen that letter till too late to get to the meeting, which he wouldn't have missed for worlds. This could not be blamed on anyone. But in his absence, his name was not put on any of the initial committees, though he was well fitted to serve on several of them. He felt that Professor Richards, one of the founders, might have kept him in mind; for Richards had been entertained by him in Madison, and knew of his work at the University. Burgess had sense enough to

know that no personal slight was intended. But could it be that the founders, largely representing Eastern universities, still thought the Middle West was out of bounds? "They can't do this to Wisconsin; or to me." Burgess probably never said these words, but they epitomize his attitude. And that is the real reason why, in the weeks preceding the Philadelphia meeting, he prepared so carefully for a discussion of Professor Richards' paper, and was so ready to detect an error when it appeared.

Burgess probably had a hand in another incident of the same day, when an invitation was extended to the society by the "Citizens' Business League of Milwaukee," to hold the next convention in that city. Milwaukee was being made famous by other means, but Burgess would do anything to call attention to Wisconsin, then to its University, then to a pioneer course in applied electrochemistry headed by a certain professor whose name could also be mentioned. Although the Milwaukee invitation was greeted with applause, many years were to pass before Milwaukee actually did entertain the society; but the gesture was another reminder that the frontiers of science were on the move.

President Richards, reminded so definitely of Burgess's presence and talents, soon put him to work on several committees, with results that were at once apparent. Whenever Burgess was on a committee, as chairman or member, something got done. Things happened, as though according to a simple formula: Meetings probably, speechmaking possibly, action surely.

Late in 1902 Burgess was put on the membership committee; in 1903 he was a member of the Committee on Papers, and in time he became its chairman. He wrote many papers himself, and constantly encouraged others to do so. The research that goes into a carefully prepared paper is good for the writer and good for the audience; furthermore—and this point was always stressed by Burgess—the frequent presentation of papers is first-class advertising for their author. Dr. Colin G. Fink, of Columbia, past-president and longtime secretary of The Electrochemical Society and well qualified to be its historian, has called attention to Burgess's wisdom and general policy in writing papers. Interviewed in 1945, Dr. Fink said, in substance, "Burgess in his early days believed in publishing his results. The consequence is that the name of C. F. Burgess so often appears in Transactions of The Electrochemical Society, especially in the earlier volumes and indexes." Dr. Fink pointed out also that the number of publications waned as the Wisconsin professor grew more busy with teaching and consulting work. But if the output waned, it never stopped. Burgess was an inveterate writer of papers, especially in his University days, and while he constantly kept his own interests in view, he never forgot his responsibility to his audience. His talks were more than merely useful; they were interesting; and he often urged other writers and speakers to bring their presentations down to earth, remembering that even scientists are human. While Burgess gave much in his talks, he also gained much from them. An interesting sidelight is contributed by a friend, who says that sometimes when Burgess was describing his experimental work, he would write a paper in a provocative way, "to learn more about the subject from those who discussed it." In this manner he did learn a great

deal, not only from remarks made on the floor of the meeting, but from comments made afterwards in letters from interested persons.

Burgess conducted an endless crusade for the writing of papers designed to interest the listener. On May 15, 1903, he wrote to C. J. Reed, first secretary of the Society, in part as follows:

> One of the criticisms which I would make upon our last program was that there was not a sufficient number of papers presented which were of direct practical interest.

To another secretary, S. S. Sadtler, he wrote in 1905:

> It seems to me that there is a tendency for men who present papers . . . to handle subjects of rather narrow import, going into them in such detail that very few of the members can follow. While such papers undoubtedly raise the general scientific tone of the meetings, they do not do the greatest good for the greatest numbers. Papers of more elementary nature should therefore be encouraged; but I believe it is more difficult to prepare such papers than more advanced ones.

Whether elementary or advanced, a steady flow of papers came along, much of it due to the influence of Burgess. The records show that during the first five years of the Society, 22 out of about 228 papers—almost 10% —originated in the Applied Electrochemistry Department of the University of Wisconsin. Not bad for the Middle West! Wisconsin's contribution—inspiring, vigorous, unquestionably scientific—was a tower of strength to the American Electrochemical Society in those early days. Burgess was busy presenting papers, urging his colleagues to do likewise, and taking active part in discussions of papers from all sources. Dr. Kahlenberg of the Chemistry Department of the University of Wisconsin, and his students and associates, co-operated generously with thought-provoking papers. West or East, there was enough credit for all; and these were fruitful and important days. The collective mind of the Society was being formed along bracing and progressive lines, lines that have seldom wavered through the years. The fact that there has been so little wavering is due to the loyalty, self-sacrifice and sheer hard work of many individuals, well represented in the single personality of Charles F. Burgess.

From 1902 on, it is hard to trace the steps in Burgess's career without reciting the story of The Electrochemical Society; that story needs its own historian. Let it suffice now to state that in spirit, if not in fact, Burgess may be classed as a founder, that he was a charter member, that he served on many committees as well as independently, and that he held many important offices. In 1904-5 he was a Vice-President of the Society; in 1906-7 he served as a Manager and was nominated for President, withdrawing in favor of his good friend Dr. Carl Hering, but accepting the office in 1907. In 1942, when the Society awarded him the Acheson Medal, he was introduced by Mr. Sidney D. Kirkpatrick as "a charter member, an honorary member, a sustaining member and a past-president of The Electrochemical Society."[239] Accepting the medal, Dr. Burgess spoke on "Early Days in our Society,"[86] and said in part:

> I wish it were possible to share with the younger men of our Society today the enthusiasm and inspiration which young fellows derived from the meetings held in those early days. For there we met Edison who was host for a day at his home and laboratory. Steinmetz entertained us at Schenectady. Acheson, the inventor of carborundum and artificial graphite; Crocker, electrical pioneer and founder of Crocker-Wheeler Company; Hall, the father of the aluminum industry; Acker, inventor of the Acker process; E. F. Northrup and Nikola Tesla—such were the leaders with whom we met on friendly basis.

Dr. Burgess then turned to one of his pet themes. He stressed the point that a young man who joins a scientific society—and attends its meetings—thereby gains friends who within a few years will be the nation's leaders in science and industry. To illustrate this point he said:

> We did not have the gift of prophecy to indicate that J. F. Tone was to become President of The Carborundum Company; that this young fellow H. A. Baker, listed as chemist and who talked about corrosion, was the future President of the American Can Company; Whitney was to become a Vice-President and Director of the great laboratories of General Electric Company; Frary, Instructor in Chemistry at Minnesota, was to be head of the group of scientists of the Aluminum Company of American; Becket to become Vice-President and Technical Director of Union Carbide Company; W. S. Landis, laboratory assistant to Professor Richards, was to become a noted economist and Vice-President of the American Cyanamid Company; Witherspoon, Chairman of Shawinigan Chemicals; and so on. This list is not a catalog, but a sample of the younger active membership of The Electrochemical Society during its early years.

A roster containing such names looks quite important; seen in the light of later years it suggests a blue book of American science. But behind the list of brilliant names lies the fact that the young society soon found itself sadly in need of funds; and no wonder; each member paid only ten dollars the first year and five dollars a year thereafter. Getting more money meant getting more members; on this point everyone agreed. But getting more members meant spending more money; and some conservatives were unwilling to risk a penny on a membership drive.

The Chairman of the Membership Committee was Dr. Alois von Isakovics, owner of the Synfleur Scientific Laboratories, Monticello, New York, makers of perfumes. To sell his products, Dr. von Isakovics used advertising, and he felt that advertising could be properly used for enlisting new members for the American Electrochemical Society. When he could not get an appropriation for this purpose, he launched a trial campaign at his own expense. The method employed was "direct mail." Although commerical in form, the campaign was professional in substance. The prospectus designed by Dr. von Isakovics was mailed only to members of other technical societies, and to other individuals whose membership would add to the strength and usefulness of the Society. Much of this activity was in 1907, at about the time when Charles F. Burgess became

President of the Society. Burgess gave Dr. von Isakovics his full backing and co-operation. The experimental membership campaign proved to be an unqualified success, and a moderate sum of money was finally appropriated for use of the Membership Committee. Burgess often spoke of the fine work done at this time by Dr. von Isakovics, without which work the Society might even have passed out of existence.

But the Society was not destined to pass out. Through good times and bad, through peacetime and war, for well-nigh half a century, it has continued to be of service to science and to mankind. All in all, it has well fulfilled the plans of those founders and charter members who greeted one another in Philadelphia on a memorable Spring day in 1902. Many of them were young men, meeting for the first time, as was the case with Charles F. Burgess and Lawrence Addicks. Years later, Addicks told his side of the story:

> At the meeting Burgess and I quickly became friends, and I took him to my mother's house, and I remember we had quite a time playing on the pipe organ installed there, and that my mother gave him astounding quantities of milk to drink. He had that 30-mile-an-hour walk that was still with him the last time I saw him.

In 1942, when Addicks sent a message of congratulation on the Acheson Medal award, Burgess replied:

> I remember very well the time you befriended me at the first meeting of the Society at Philadelphia, April 3, 1902. You invited me to your house and made me feel at home. I did not know that you were the future "Silver King."

Neither did Addicks. Nor did Burgess see the far-flung developments of his own career. Both of them had hopes and dreams, for themselves and for the new-born organization, toward which, as to a new-born infant, they cherished feelings close akin to love. Many years later, only a few weeks before Burgess left this earth, he wrote in his notebook some words of pleasant memory and kindly advice:

> I have a love for that society. . . . I owe much to it, for it was a source of inspiration.
>
> I believe any young man ambitious to make a position for himself can do well to identify himself actively and consistently with a national organization bearing on his line of interest.

11.

The Johnson Contract 1901-1904

WE have spoken several times of Burgess's contract with "the four Johnsons" of the Gisholt Machine Company, signed on the last day of the Nineteenth Century; and we have seen that by the summer of 1903 the arrangements under the contract seemed likely to be terminated. A little later they *were* terminated, leaving behind them the record of a transaction which in some ways is unique. Because of its unusual nature, and of its far-reaching influence on Burgess's career, the transaction deserves a chapter to itself.

It may be well to remember that although the contract was dated December 31, 1900, Burgess's experimental work for the Johnsons actually began July 1, 1900, six months earlier. This allowed time for discussing contract terms and possibilities of profit.

The Johnsons expected to profit from new processes and products to be developed by Burgess. Burgess expected to profit from eventual ownership of one-fifth of the capital stock of a company to be organized when the time was ripe, the other four-fifths to be owned by the Johnsons. He was also to receive, as a sort of bonus, certain percentages of the net profits of the business. After July 1, 1901, he was to devote "all his time" to the interests of the proposed corporation, and to receive from the Johnsons a salary of $2,000 a year. For these considerations he agreed, according to Article 4 of the contract:

> To assign to the proposed corporation all his inventions and patents, or interests in inventions and patents that may be issued to him or to parties with whom he is interested; and he further agrees that all inventions that he may make, and patents granted thereon, shall become the property of the proposed corporation as soon as said corporation is duly incorporated.

In spite of the fact that after July 1, 1901, Burgess was supposed to devote all his time to the business, he did not resign his position at the University. Adopting a plan in some ways without precedent, he managed, as he told his father, to serve two masters. To fulfill his obligation to the University, he did some teaching in person and some by means of assistants. In order that the Johnsons might still profit from "all" his time, he turned over to them the salary he received from the University. He turned over also the fees he received from consulting work, and even

the small amounts he earned by writing articles for technical magazines. Two laboratory assistants helped him by teaching his classes in 1901-2 and 1902-3 respectively. One of them was listed in University records as "Assistant in Electro-Chemistry, 1901-2," and the other as "Student Assistant in Applied Electro-Chemistry"; but they received all, or substantially all, of their pay from money supplied to Burgess by the four Johnsons. No doubt this arrangement had been discussed by Burgess with his superiors at the University, and they had permitted it because they were persuaded that it would not hinder, and might help, his power to serve his students and the State.

As we have already learned, much of the steady, continuous experimenting under the terms of the Johnson contract was done for Burgess by Carl Hambuechen, who, although for a short time he helped teach Burgess's students, was not officially an instructor. From July 1900 on, Hambuechen's salary came from the Johnsons, and from September 1901 he devoted his entire time to the work in which they were interested. In 1901-2 Arba B. Marvin, as assistant in electrochemistry, worked under an arrangement similar to Hambuechen's, and in 1902-3 Marvin was succeeded by James G. Zimmerman; Zimmerman, however, was paid in part by the University. In September 1903, when the arrangement had been in operation for about three years, Burgess sent the Johnsons a report, recalling in some detail what had been accomplished, or at least what had been done.

According to the report, the first experiments had been with a form of uni-polar dynamo, which was found to be unsatisfactory on account of heat generated by the friction of the mercury used in its construction.

Then, for almost a year, experiments were devoted to the electrolytic production of white lead; also of chrome yellow and similar compounds. This line of research was abandoned because of the necessity of working on a large scale to make it profitable; but Burgess learned some lessons of value about pigments.

A great deal of time had been put on the fused-electrolyte aluminum electrolytic rectifier, a device of rich promise. A number of rectifiers had been made and sent out for testing under industrial conditions. The patent situation was not entirely clear at the time of writing this report, but Burgess's hopes were high. It is interesting to note that he gave generous recognition to a rival device, also in the development stage, the Cooper-Hewitt mercury-vapor-arc rectifier, calling it "the most promtising competitor." Speaking of his own rectifier, he also had this to say:

> Rather than take up the manufacture and promotion of the rectifier, it seems to me desirable to find a customer for the patents involved, or have someone take it up on a royalty basis. For various obvious reasons it seems to me that the former would be preferable, inasmuch as the latter might subject us to considerable expense for patent litigation, etc. I believe that a customer can be found for these patents provided a reasonable figure is named. An arrangement could probably be made whereby any further laboratory work along that line would be paid for at a profitable figure.

Various minor lines had been taken up, such as zinc plating, plating on aluminum, and the production of electric furnace materials; also the design and construction of new forms of apparatus such as rheostats, condensers, and galvanometers. A new means for suspending anodes in electrolytes had been developed, which was likely to be of value. Regarding zinc plating, Burgess reported:

> There was placed on the market a process similar to ours and giving more satisfactory results, and the work was therefore discontinued.

Again he was ready to acknowledge merit in a competitor's device. But the experiments had not been a total loss, for he added:

> We found a means for producing a smooth corrosion of zinc from the anode, and this idea will probably have some commercial value.

Electrolytic iron came in for mention. Burgess pointed to the growing interest in pure iron, and added:

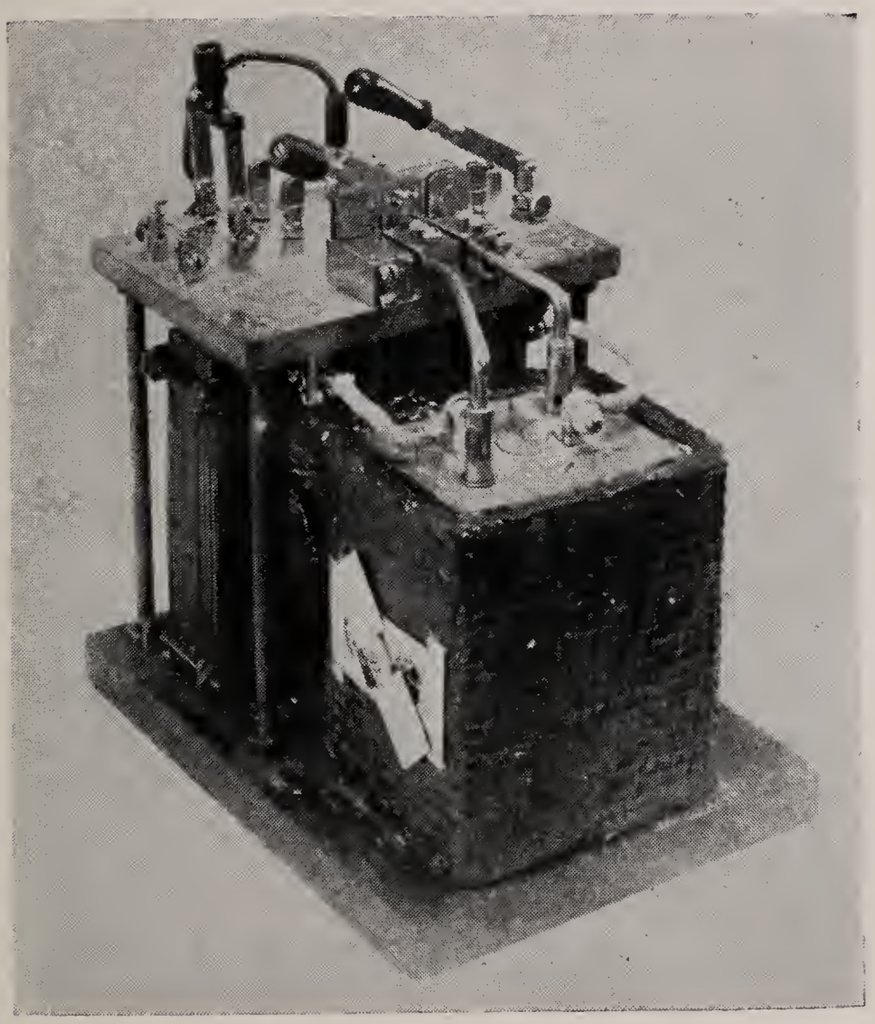
> From what I have been able to learn, I believe that we are considerably in advance of others. . . . At present we are making about four pounds a day, and it will be desirable to increase the production before long. To do this will require a larger plant both as regards size and number of tanks, and it will probably be necessary to carry on this work away from the University laboratory, both on account of secrecy and (to avoid) using power paid for by the University.

Someone—probably the Johnsons—had suggested that it might be well for Burgess to cut loose from the University, and literally devote all his time to experimental work for the projected company; but in his report he said:

> This would involve losing the advantages of this laboratory, and would therefore be undesirable. We are now in a position to obtain the services of any of the best students should it be desirable to employ them, and some of our experimental work can be carried on by them at reasonable rates.
>
> There are to be a number of graduate students during the coming year, and it is possible that the lines of investigative work which they will take up for their theses may be to our advantage. Among these graduate students are two electrochemists from the East.

The two men from the East were probably George M. Norman, of Pennsylvania, and Oliver P. Watts, of Massachusetts. Norman was destined to stay at Wisconsin for about a year, and Watts for well over forty years. Stressing the advisability of staying at the University, Burgess stated in his report:

> Our laboratory is undoubtedly the best one in the country for carrying on experimental work in electrochemistry, and



The Electrolytic Rectifier

> considerable improvement will be made during the coming year. The amount of space will be nearly doubled, and we expect to have much better facilities for carrying on electric furnace work. . . . Our present laboratory equipment is worth $10,000 and we have about $2,000 a year for addition to equipment.

As a further inducement to the Johnsons to continue under the terms of the 1900 contract, and as an additional reason for carrying out the original intention of forming a company, Burgess added:

> Still another line of work would be expert and consulting work, which could be obtained by proper advertising, and which might be made to aid materially in maintaining our laboratory work.

This last suggestion was made to meet the objections of the Johnsons, who now, in a depression year, were feeling that they could not afford to invest any more money in a venture which, however promising, had not yet broken even. After crediting the money received from Burgess, representing his University salary and his other earnings, they were still short $7,303.00. They decided against continuing; and Burgess was faced with the necessity of carrying on alone. For a while the situation was rather trying; he was still obligated to pay Hambuechen about $90.00 a month, which now would have to come out of his University salary. Hambuechen understood, and began looking around for other employment, at least until such time as Burgess might be able to establish a research organization of his own.

Although Burgess was disappointed, and indeed annoyed, his situation was not desperate. When the Johnson arrangement terminated, so did the requirement that he turn over his salary, and his outside fees for consultation, sundry research, and the writing of articles. And he had gained experience which in many ways was to help him in the years to come. One thing he had learned—and the Johnsons with him—which he never forgot, was that it took a long time to bring an idea from its first inception to a point where it might be successfully commercialized. In later years he often mentioned this fact, and in time he came to the conclusion that the average interval between inception and profitable sales was seven years. In his high hopes for results from the Johnson enterprise he had probably been misled by the quick success of the process for debrassing bicycle frames, which he and Murray C. Beebe had put on a paying basis within months instead of years. The debrassing episode was exceptional, and even it was profitable for a few years only.

At the present day, such an arrangement as Burgess had with the Johnsons would be unthinkable. It was made at a time when people were bold enough to try almost any sort of experiment; and judged by its results it was, on the whole, beneficial. It provides a curious footnote to the fascinating story of research and development.

12.

Associate Professorship at Wisconsin 1904—St. Louis Fair

IN the life of Charles F. Burgess, every incident, including the least, seems to have been linked with every other incident, including the most important. Perhaps it is so with the lives of all of us, could we but see them through the eyes of Providence. Inklings of such vision come only in the after-years, when we begin to look upon our days as a tale that is told.

Looking back to January 1904, as Burgess celebrates his 31st birthday, we find him interested in the approaching visit of one of his heroes, Professor Elihu Thomson, noted electrical engineer, of Lynn, Massachusetts, leading scientist of the General Electric Company. Dr. Thomson had been invited to Madison, to receive the honorary degree of LL.D. He was of interest to Burgess for several reasons: He had for years employed Burgess's uncle, Gabriel Heckman, as a skilled mechanic; he was to play an important role in the International Electrical Congress at St. Louis; he had taken out more than 500 patents, including one, in connection with fused quartz, in which he was just ahead of Burgess; "showing," wrote Burgess to a friend, "how great minds run in the same channel." On this occasion the great minds did not have much time for comparing notes; Professor Thomson had to hurry back East, and Professor Burgess had to keep right on with his work, teaching and researching. Some thought would also have to be given to the paper on electrolytic iron which he and Hambuechen were writing, and which he was scheduled to read at the April meeting of the American Electrochemical Society.

In May the Board of Regents notified Burgess that he was about to be promoted to Associate Professor of Electrical Engineering with a salary of $1800.00. This was only $200.00 more than he had received as *Assistant* Professor, but it was welcome. In addition to keeping up with the household expenses, carefully administered by his wife, he was always spending his own money on classroom material and specimens not covered by University appropriations. A few days after hearing about the $200.00 raise, he was hoping to buy some radium ore from A. B. Frenzel, of Denver; but on May 21 Frenzel wrote him that this was out of the question, as all of his small supply had gone to Professor and Madame Curie in France, and that it was impossible to obtain any more except at prohibitive cost. A year earlier Burgess had tried to get some radium from his friend William J. Hammer, of New York. Hammer, an

outstanding electrical engineer, long associated with Edison, had brought a small amount of radium from the Curie laboratories in 1902, but he had not been able to spare any for use at Wisconsin.

Burgess contented himself with some experiments with molybdenum ores, and did not know for some years that his failure to get radium then was a blessing in disguise. Virtually all early radium researchers underwent great suffering from unguarded handling of the strange new element, and many of them paid for their researches with their lives. The heroic Marie Curie managed to outlive many of her colleagues, but when Burgess saw her, years later, she was dying by inches, a martyr to the ravages of radium poisoning. Lack of funds saved Burgess from a similar fate; but it did not hinder him from experimenting with elements less exciting than radium, especially with iron. The story of his work on "electrolytic iron" will have a chapter to itself. Meanwhile, still glancing back at some of the far-reaching happenings of 1904, we see that in June Burgess was planning one or more visits to the Louisiana Purchase Exposition in St. Louis, where the Department of Electricity had offered him an appointment on the International Jury of Awards, and where he would be able to exhibit an unusually large specimen of electrolytic iron.

As Commencement drew near, Burgess gave hard-boiled counsel to some of his graduating students. One of them quotes him as saying "You boys think you know a lot, but as a matter of fact you know very little; my advice is that you put on overalls and go to work." As always, he stressed individual work, individual research. This year, however, in the days just preceding Commencement, work and research came almost to a standstill, as the entire student body joined with the faculty, and with noted guests from other lands, in celebrating the Semi-Centennial of the University of Wisconsin. The Jubilee exercises, June 5th to June 9th, were dated not from the founding of the University, but from its first commencement in 1854. In a secondary way they served to celebrate the fact that the new President, Charles Richard Van Hise, was the first alumnus of the University to become its leader.

Years later, Burgess liked to tell a story about the 1904 Jubilee. It was a story about color; part of it we are able to give in his own words from a pencil memorandum he made in 1941:

> By what words, formula or materials can the color known as "Cardinal" be defined? This is the official color adopted by the University of Wisconsin. In 1904 that university had a jubilee celebrating its first half-century of existence. A part of this celebration was the granting of many honorary degrees upon people of note who were coming from various parts of the world. To lend color to the proceedings it was considered proper that the doctors' hoods should be lined with Cardinal—the official color of the University.
>
> Samples of silk of cardinal color were submitted by various suppliers, and by looking at these samples it was seen that if the choice of material were left to individual selection the affair would take on the appearance of a Polish wedding.
>
> It was at this juncture that the question was asked; What is Cardinal? Not one member of the faculty could answer.

> I believe the Vatican was appealed to for a definition, or at least a sample out of which cardinals' robes were made. Could such a sample be obtained—and how large—so that secondary samples could be made as a standard for the coming years? Even if such a sample were obtainable, would it fade, or change color?
>
> The question became more and more complex, and in desperation it was, I believe, left to this process—leave it to Marshall Field—order some Cardinal silk and use what comes.

So the story went; but in the researchful mind of Charles F. Burgess it did not go far enough. He became interested in all methods for the standardization and identification of colors, especially, years afterwards, in the automatic color-analyzer developed by Drs. Joseph Razek and Peter J. Mulder of the University of Pennsylvania. With that device, which later won for its inventors a Certificate of Merit from the Franklin Institute, he could have drawn up an accurate specification of Cardinal or any other color.

Tragedy, almost a total stranger to the Burgess household, did come in June, a few days after Commencement. A little girl was born, and quickly died. To Charles and Ida the loss of their first child was like a trial by fire, welding them in an even closer affection than before. They came through bravely, with deeper human understanding and greater strength for the future. In their hearts they knew, beyond all doubt, that their little one had not been born in vain.

And life moved on. A life of ever-growing household responsibilities for Ida, ever-widening professional activities for Charles. Once more his attention was attracted to a "world's fair"; this time it was the Louisiana Purchase Exposition in St. Louis. It brought to St. Louis several important scientific meetings, including the First International Congress of Arts and Sciences, the Fifth International Electrical Congress, and the Sixth General Meeting of the American Electrochemical Society. Burgess was naturally interested in the first of these, and took an active part in the other two.

When he was not attending meetings, serving on committees, or writing reports, he made it his business to visit and study the exhibits. One piece of equipment, installed by Chester A. Thordarson, was of especial interest. It was a 500,000-volt transformer, mounted in a wooden cabinet on casters, so that it could be moved easily. The general public was not much interested in transformers; not one visitor in ten thousand knew what they were. But Thordarson, who liked putting on a good show, gathered big crowds by demonstrating a new method of frying eggs. No stove; no fire; just an ordinary table and an iron frying pan. In the pan were eggs, and when Thordarson said "Fry," they fried, visibly and audibly. Some of the bolder spectators tasted them, and pronounced them to be real eggs. It seemed like magic, even when Thordarson carefully explained that he was using electric power in the form of eddy currents, which, if turned on long enough, would bring the iron pan to red heat.

One day, when Burgess was watching this performance, and studying its effect on the ever-changing audience, an earnest-looking woman

raised her hand. When she caught Mr. Thordarson's eye, he politely asked what she wanted to know. She replied solemnly, "I am magnetic. . . . My body is full of magnetism. . . . I can tell you when your current is on and when it is off. . . . I can do it without frying pans." "Fine!" said Thordarson, "I'll turn it on and off, and you can tell me which is which." The magnetic woman guessed right a few times, then wrong a few times, and after a number of attempts her score was only 50% correct; which proved nothing at all. People in the crowd began to laugh. And then was heard the voice of Charles F. Burgess. Boldly he announced, "I have the same power—but I can feel the current every time. All I need do is hold my hand above the table." Thordarson, who did not know Burgess, although he had been corresponding with him several years, figured that now it was a man's turn to make a fool of himself; but he said "O.K. . . .If you want to try it, go ahead." Once more the test began, and Burgess, now the center of attraction, began to say in a clear, unhesitating voice, "The current is on. . . . The current is off. . . . The current is on. . . . The current is off." He was right every time. After this had gone on for several minutes, Thordarson gave up. He turned to the crowd and said, "Here, at last, is a man who can feel magnetism." Then, seeing that Burgess was walking away, Thordarson ran after him, eager to know who he was. When Burgess made himself known, a lively conversation followed. They talked about Burgess's activities at Wisconsin, and of the Thordarson equipment he had been using there; they talked about the varied attractions of the exposition. They talked about everything but the seeming miracle which Burgess had just wrought at the Thordarson exhibit; that wasn't discussed till long afterwards (See Chapter 28). At any rate, this meeting in St. Louis marked the beginning of a long and loyal friendship.

Burgess's three weeks in St. Louis were "one continual hustle," but, as he wrote to his father, "I consider the time spent there very profitable on account of the many friends made, information and new ideas acquired, and inspiration received." Remembering how he had out-magnetized the magnetic woman, he might have added "and fun." All this, and money too; for he was paid an honorarium of $7.00 a day for his work on the jury of awards, plus traveling expenses; the total amount was $158.05. Shortly afterwards, the Exposition Company sent him a "commemorative diploma" and a medal "in special recognition of your active interest and efficient cooperation in the Universal Exposition of 1904."

Later on, after again describing the Exposition to his father, he wrote: "I am thankful to be back among ordinary people once more. . . . I got so tired of meeting great men." Tired, he doubtless meant, of meeting them in such concentrated doses.

Some of the foremost names of his student days were there in the flesh: Ostwald, Arrhenius, van't Hoff, all three of them; Sir William Ramsay, representing the Royal Institution of which Burgess was to become a member; Dr. Elihu Thomson, who opened the Electrical Congress with a speech that warmed his heart, stressing the value of research, both for itself and for its commercial possibilities; Henri Moissan of

Paris, he of the man-made diamonds and the electric furnace; and many other supermen of science.

Attending the Congress was Charles P. Steinmetz, author of two books which had doubtless been read carefully by Burgess. These were *Theory and Calculation of Alternating Current Phenomena* (1897) and *Theoretical Elements of Electrical Engineering* (1901). Thirty-nine years old, Steinmetz was Professor of Electrophysics at Union University, in 1901-2 he had been president of the American Institute of Electrical Engineers, and since 1893 consulting engineer for the General Electric Company. In 1900 he had been active in founding that company's pioneer laboratory for scientific research, which was to grow and flourish under the direction of another young man, Willis R. Whitney, chemistry professor from the Massachusetts Institute of Technology. Charles Proteus Steinmetz was a picturesque and dramatic character, and a picture found in Burgess's files shows him sitting in the front row of a group of famous men attending the Congress.

One of Burgess's colleagues on the International Jury of Awards, Electrochemical Group, was Dr. Samuel Sheldon of the Brooklyn Polytechnic Institute, formerly assistant of Kohlrausch in his famous determination of the ohm. On September 11, Burgess wrote to his wife:

> Professor Sheldon, a member of the committee, has asked me to go into partnership on a textbook of electrochemistry. Says there is a great field for it, and that if I would do so I would get more consulting and expert work than I could take care of. I would take it up this winter if I were not so lazy, but perhaps with a good private secretary it can be managed.

The good private secretary was probably Mrs. Charles F. Burgess, but as it turned out she did not have to help with the book. Burgess and Sheldon found that they held conflicting views about some phases of electrochemistry, and dropped their plans for collaboration.

Burgess saw a good deal of his friend William J. Hammer, of the Edison companies, who had several good reasons for attending the Exposition, one of them being that he was exhibiting his very valuable historical collection of incandescent electric lamps. The exhibit was awarded a grand prize, and Burgess was inspired with the ambition of forming a similar collection for himself.

The American Electrochemical Society had invited Burgess to give a paper at the meeting which it held in St. Louis during the Exposition, but he politely declined. Explaining this action to Carl Hambuechen, he wrote: "I do not like to read papers at a meeting connected with an exposition, as they very seldom receive much attention." Although he presented no papers, he took an active part in the discussions, and on more than one occasion, presided. Besides serving as Secretary of the Electrochemical Jury, he expanded the notes of that Jury into a paper on "Electrochemistry in 1904 as represented at the St. Louis Exposition." He presented it before the American Electrochemical Society in 1905.[75] Mention of his own contribution does not appear till the very end of the report, as follows:

> In the Educational Building, among other exhibits from the University of Wisconsin, was shown a piece of electrolytically refined iron, weighing 30 pounds. It was the work of Prof. Charles F. Burgess and Mr. Carl Hambuechen, and is probably the largest piece of electrolytic iron which has been produced so far.

A large proportion of the electrochemical exhibits illustrated the art of making batteries, both primary and secondary; and about a third of Burgess's 21-page report was devoted to describing batteries of various types.

At one of the meetings of the main congress, Burgess might have heard an eloquent address by the head of Princeton University, on "The Unity and Variety of Historical Science." He probably did not hear it, but eight years later he did vote for the speaker, Woodrow Wilson, because he believed that the country would be benefited "by the election of a college professor as President."

Sunday night, September 4, 1904, in a letter to his wife, he told of an interesting conversation with Carl Hambuechen:

> This morning I took a two hours ride over to East St. Louis to take dinner with my former "pardner." I think we were both equally glad to see each other. We talked like two women until six o'clock . . . I am very proud of the fact that he is making good, they having recently created an experimental department with him at the head. . . . He has already effected savings amounting to over $20,000 a year, and says he is going to make further economies amounting to many times that figure. He gets, however, only $1200.
>
> Hambuechen is anxious to make connections with me again, and he has some very good new schemes which ought to be successful. Have advised him, however, to get some more experience and inside information, so that when we tackle it again it has got to go.

On more than one occasion, in speaking of conversations with men of similar interests, Burgess said "We talked like two women," or "like two schoolgirls." To his mind the comparison was natural, and, as in the letter to his wife just quoted, it was friendly. But although there was nothing unchivalrous about him, he did have some fixed ideas about the part that wives should play in business matters, and particularly in technical matters. In the words of one of his friends:

> He did not like the presence of women, that is, the wives of the members, at meetings of technical societies. He thought that meetings should be strictly for the purpose at hand—the improvement of the individual in technical lines; also for the making of business contacts.
>
> C. F. derived his enjoyment from the exchanging of technical information and the improvement of his mind along technical and business lines. The wives of the members could not contribute, and therefore he saw no reason for them to be there. So far as I know, Mrs. Burgess never attended a meeting of The Electrochemical Society.

Mrs. Burgess didn't have to. She understood and respected her husband's viewpoint, and even when she was not present, her quiet influence reached out to him, upholding, inspiring and encouraging. There were times when he needed encouragement. In an otherwise cheerful letter, on the occasion of his father's 71st birthday, there was a negative paragraph, closing with the words, "I am tempted to believe that I am something of a failure." Promptly on November 11th, the birthday itself, Father Burgess penned a fatherly reply:

> I hope your high ambitions may be realized, and you established in a position of which you as well as I may be proud. I will say that I *am* proud of you. Don't talk of being a "failure."

Charlie had expected his father to come through with some such note of reassurance; and in the expectation he had already assured himself. By the time the letter came, his mind was free from all misgivings. Work was piling up, but it was the kind of work he liked; life in general was interesting, and in at least one respect exciting. Excitement colored the closing months of 1904, as Burgess anxiously awaited word from Washington, where the Carnegie Institution had been asked for a grant of money for bigger and better research in the field of electrolytic iron.

The answer from Washington might have far-reaching significance in the shaping of Burgess's career. Would it be yes or no?

13.

Carnegie Institution Grant—Electrolytic Iron and Alloys—Copper Steel Controversy

"A PERIOD of breathless waiting." Burgess used these words to describe the weeks that followed his application for the Carnegie grant. The period was breathless because without the Carnegie money it would be impossible for him to continue a line of research, already showing great promise, in which pure iron was being produced by electrolytic means. Burgess had been interested in this line of investigation for several years, aided by his former student and collaborator Carl Hambuechen. It was one of the long-range researches encouraged by Professor Charles R. Van Hise, who started teaching at Wisconsin in 1879 and became its president in 1903. President Van Hise, himself author of several works on the iron-bearing districts of the middle west, was familiar with the program of the Carnegie Institution. In the summer of 1904, when application for the grant was made, it received his unqualified endorsement.

Burgess's own native stubbornness may have been a factor in the case. Hints had been made that in devoting so much energy to the production of pure iron he might be wasting his time, and such hints had sometimes been accompanied by quotations from standard authorities. Perhaps one of these was the famous metallurgist William H. Greenwood, who in 1884 had said on the very first page of his book, *Steel and Iron*:

> Chemically pure iron exists only as a curiosity, and has no practical application in the arts. It is void of commercial value as a constructive material, and cannot be prepared upon a large scale.

To Burgess such a statement was a challenge. He *wanted* to prepare this material upon a large scale, he *wanted* to prove its commercial value, he *wanted* to give it practical application in the arts. Investigation of iron and steel alloys had been limited greatly by the lack of a relatively pure iron as a starting material. Burgess, faced with the fact that iron in its natural state is closely bound up with other substances, was confident that it could be loosed from those substances by electrolysis. To speak

of "loosing" is not as unscientific as it may seem. Loosing in Greek is *lysis,* and loosing or separating anything—for example, iron—by the electric current is electrolysis. Since we are dealing with words, it may be well to remark that "pure" when spoken of iron is a relative term. Even the electrolytic process does not remove *all* impurities; it does reduce them to a point generally considered negligible.

As early as 1898 Burgess had been interested in the problem; indeed he had produced electrolytic iron of a kind; but as explained by one of his colleagues:

> It was only possible to electrodeposit thin sheets of the material, in the form of a coherent deposit. . . . Anything thicker than this would deposit in the form of a porous or powdery material which had no value in the commercial world.

By 1901 Carl Hambuechen was tackling the same problem, and late in that year or early in 1902 he showed Burgess a small piece of iron "about the size of a half dollar" which he had produced. He had succeeded in depositing a fairly thick layer of iron which was not porous or powdery. Burgess was delighted. Here was success on a small scale; he would now try to demonstrate the possibility of producing pure iron on a large scale at low cost. The program called for more and more research. The iron and steel industry was growing fast. Much had been said about the importance of alloy steels, but little had been done to study and classify them. The situation seemed made to order for Burgess; and he was not slow in grasping it. Past attempts to produce electrolytic iron had yielded only a few grams of usable product, and the plan now was to manufacture tons, by a continuous process similar to that used for copper refining. This meant work. But Burgess was not afraid of work; aided by Hambuechen he went right ahead. By 1903 he had made some measurable progress, for, as he explained later in a public address:[33]

> A refining process was developed, and after continuous operation of a small electrolytic tank for forty days and forty nights, a plate of iron weighing 20 pounds was brought to view.

He spoke figuratively. The actual time elapsed was nearer twenty-eight days, but he used the Scriptural number forty to express a full period of anxiety. In this case it was anxiety preceding joy; for, he continued:

> If the alchemist, seeking to transmute base metal into gold, had found that he could pour a stream of the precious substance from his crucible, he would have had no greater thrill than we on taking from our tank that white, shiny, warty chunk of iron.

One shiny, warty chunk was not enough. A big supply was needed, not only for their own use but to share with other investigators:

> But our funds were exhausted and we could not go on. Then a bright ray of hope came to us in the public announcement that the Carnegie Institution of Washington was about to make available to worthy investigators various sums of money for carrying on meritorious research projects.

Electric Furnace used in Electrolytic Iron Alloy Investigation

Burgess felt that he and his associates were worthy and that their plan was meritorious, but, as he said, "We had to prove it." In July he wrote to Hambuechen, who had moved to East St. Louis, describing his efforts to secure the Carnegie grant. President Van Hise and the head of the College of Engineering, Dean F. E. Turneaure, were both giving enthusiastic support. And yet, Burgess confided, he was doubtful of success.

There were some reasons for being doubtful. The twenty-four trustees of the Carnegie Institution seemed rather distant, rather non-technical, rather old. They were men of very high standing—some of the nation's best—but they were mostly bankers, merchants, authors, lawyers, statesmen and physicians. In the main they were easterners; only one member, Senator John Coit Spooner, was from Wisconsin. Only three might be expected to know about electrolytic iron; the Swiss-American naturalist, Alexander Agassiz, the astronomer and physicist, Samuel P. Langley, and the famed geologist, Charles D. Walcott. The trustees' ages averaged over 64; Burgess was under 32; he often wondered what was to be his fate at the hands of the twenty-four old men in Washington.

So much for doubts, but now for hopeful signs. Trustee Samuel P. Langley would at least remember Wisconsin, having received its honorary degree of LL.D. Daniel Coit Gilman, chairman of the board, had just attended the Wisconsin semi-centennial, and had received the same degree. Trustee Spooner was a Wisconsin alumnus and former regent, with four Wisconsin degrees, and now represented Wisconsin in the U. S. Senate; surely he could be counted on. And what about Andrew Carnegie himself? He wasn't a member of the board, but his trustees might remember how proud he was of the title of Ironmaster. Then, the trustees would be considering endorsements from prominent metallurgists, notably those from Henry M. Howe and Robert A. Hadfield; probably also from another helpful friend, Professor H. S. Carhart, of the University of Michigan.

Howe, one of America's outstanding scientists, professor of metallurgy at Columbia, had just published his book, *Iron, Steel and other Alloys.* He was keenly interested in Burgess's activities, and gave unqualified support to his application for the grant. Professor Howe also enlisted the support of Burgess's friend Professor J. W. Richards, then Past-President of the American Electrochemical Society, and Professor R. S. Woodward of Columbia University, then likely to become President of the Carnegie Institution. Another powerful supporter approached by Howe was Dr. Eugene Haanel, famed mineralogist, Superintendent of Mines for Canada.

Hadfield, soon to earn a knighthood and then a baronetcy, had been appropriately born in Sheffield. There he achieved international fame both as metallurgist and industrialist. In 1904 he was a member of the council of the Iron and Steel Institute, a British association enjoying high prestige in the United States. He could be counted on as a very influential supporter, and would be able to back his recommendation with first-class evidence. Upon first hearing of the electrolytic iron experiments at Wisconsin, through publicity given the Burgess-Hambuechen paper of April 9, 1904, he had written to Burgess asking for specimens; as soon as the specimens reached England he had tested them, and had found them to be of unmistakable value. Early in September, Hadfield had

written to his friend, the secretary of the Carnegie Institution, who, by good fortune, was one of the twenty-four trustees already named, Charles D. Walcott. Incidentally, Dr. Walcott had visited the Exposition in St. Louis, and *if* he had entered the Educational Building, and inspected the exhibits from the University of Wisconsin, he *might* have seen the largest piece of electrolytic iron in the world—"the work of Prof. Charles F. Burgess and Mr. Carl Hambuechen." Burgess had been advised to exhibit this important specimen by another eminent metallurgist, Dr. John A. Mathews of the Crucible Steel Company of America; and Dr. Mathews helped also in the matter of the Carnegie grant. Burgess indeed was honored by his friends.

Thoughts such as these filled Burgess's mind for many weeks, the aforementioned period of breathless waiting. But the waiting had to come to an end; and on December 13, 1904, at 10 o'clock in the morning, at the New Willard Hotel in Washington, the fateful meeting of the Board of Trustees of the Carnegie Institution was called to order. Of the twenty-four members, only twenty were present. As luck would have it, the absentees included two of Burgess's hoped-for supporters, Dr. Agassiz and Senator Spooner. But this made no difference; details as to the issuance of grants had doubtless been worked out in committees beforehand; and at the afternoon session resolutions were passed, appropriating a total of $478,000, of which $2,500 was allocated to "Burgess, Charles F., University of Wisconsin, Madison, Wisconsin, Grant No. 247. *Investigation of the properties of electrolytic iron and its alloys.*"

That $2500, and the opportunity it represented, meant more to Charles F. Burgess than if he had received the entire $478,000 without the right to use it in research. It was indeed joyful news that came to Burgess, and his wife, and his associates, about ten days before Christmas; it called for, and received, appropriate celebration. Not only for one year, but for several, provision had been made; the Carnegie trustees had set aside $10,000, to be used for this research project over a period of five years. Then, in the words of Burgess:[33]

> With such an opportunity open before us, other assistants were employed, several tons of electrolytic iron produced, over a thousand alloys made, and the results published.
>
> The joys derived from this work were shared by a group of able and enthusiastic young men who have since earned honorable positions in the scientific and technical field. The group included Oliver P. Watts, Carl Hambuechen, James Aston, John Thickens, Otto L. Kowalke, and A. Hoyt Taylor.

A. Hoyt Taylor worked out the first magnetic tests on the electrolytic iron.[4] Later, with the Navy Department, he earned fame in another field, that of radio engineering, and was a leader in the development of radar.

The investigation under Grant No. 247 was begun in February 1905, under the direct charge of Dr. Oliver P. Watts, and continued with more or less activity through 1909. Detailed reports of progress were made. Many years later, Professor O. L. Kowalke reminisced:

> In those days part of my pay came from the Carnegie grant. Burgess was insistent that a report be rendered to the Carnegie Institution every six months. It was my business to write the report, and Burgess would go over it with me."

The reports must have been reassuring; payments under Grant No. 247 were made for several years, until the $10,000 had been used up, and by 1910 this phase of the research came to an end. When mentioning the cost of the work as $10,000, we must not forget the very real contributions made by the University in furnishing space, light, heat, power and other items, including, of course, generous co-operation from the teaching staff. Nevertheless, the record shows that with a moderate expenditure Burgess had done a monumental job, and had earned publicity which was to add prestige to his name for many years to come. Much of this favorable notice came through publication of the data obtained during the research. Many papers were published by Burgess, some of them alone and some shared with his co-workers.[3–22] Reprints of several of these papers were still in demand forty years later.

Your true researcher is a *patient* man. He has to be patient, because, in his search for truth, he so often finds that he has been mistaken. He has to be patient, because his fellow-men are so often impatient; they keep knocking at his study door and asking for results, discoveries, profits! But he, the true researcher, keeps his head. When he uncovers a mistake, even one of his own, he marks it up not as a loss but as a gain; for Truth has gained, and he has gained with truth. And sometimes his labors are rewarded in a material way; sometimes he *can* give satisfying answers to the people who constantly call for tangible results. In the early stages of Burgess's work on electrolytic iron he often referred inquirers to the paper he and Hambuechen had prepared in April 1904,[2] where they could read statements like this:

> It having been shown that it is possible for electrolytic iron to be produced at a small cost, the question naturally arises as to what uses there may be for it.
>
> The first suggestion which naturally presents itself is that, on account of its purity, it would serve as a basis for investigating the properties of iron and its alloys.
>
> Starting with the pure iron, alloys of a pre-determined and definite composition can be produced, thus making such investigations of greater simplicity.
>
> Electrolytic iron naturally offers the means of manufacturing chemically pure compounds, and of standardizing solutions in the anlytical chemical laboratory. The electrolytic iron, in addition to its purity, has an advantage for the purpose just mentioned of rapidly dissolving in an acid solution.

It may be remarked in passing that presentation of the Burgess-Hambuechen paper, source of the statements just quoted, had much to do with electing Burgess to the office of President of the American Electrochemical Society in 1907-8.

Later on, at the end of the investigations under the Carnegie grant, Burgess prepared a formal statement for the use of Dean F. E. Turneaure,

head of the College of Engineering. In this statement he was able to report:

> Nearly ten tons of the material have been produced and over 1,000 alloys have been made from it. Tests on all of these alloys show that some of them have unusual and valuable properties, such as extreme strength, great hardness and high magnetic qualities, and being suitable for such uses as automobile parts where great strength is required, for razor blades and cutting tools and the manufacture of dynamos and transformers.
>
> While the principal use of this pure iron appears to be as a base for the manufacture of alloys, other important uses are found for it.
>
> In the Department of Pharmacy it has been discovered that iron compounds of exceedingly high chemical purity can be made from it. It is estimated that at least fifty tons of electrolytic iron can be used each year for the production of compounds used in medicinal and pharmaceutical purposes.

"Electrolytic iron in medicine." It was a thought that fascinated Burgess. He corresponded with several pharmaceutical houses regarding the use of his electrolytic iron for producing medicinal iron compounds. Drug manufacturers agree that medicinal iron must be as pure as humanly possible to refine it, and that electrolytic iron would surely be just right; but "Burgess Iron" did not find its way into America's pills and potions.

The "high magnetic qualities" of some of the alloys mentioned in the report were referred to long afterwards in a letter which Burgess wrote to his friend and sometime collaborator James Aston, in which he said:

> Although you and I never pushed ourselves forward in claiming credit for some of the discoveries which we made back in the "horse and buggy" days, the records do show that we were pioneers in the making of what is now known as Permalloy and some of the other high-grade magnetic materials now on the market. The Allegheny Ludlum Steel Corporation for example has given us credit for starting them in the manufacture of some of their high-grade transformer irons.

Burgess's formal statement to Dean Turneaure continues:

> Another one of the various uses is for the rapid generation of pure hydrogen, a gas which has various industrial applications including the inflation of balloons.
>
> Professor C. F. Burgess, under whom this work has been carried out, estimates that the electrolytic refining of iron ought not to exceed a cost of $10 a ton, which with the cost of $20 a ton for raw material makes a total cost as low as that for many grades of commercial material of far lower purity.

Several years before Burgess prepared this optimistic statement, his work on electrolytic iron had "almost cost him his job at the University of Wisconsin." The words just quoted are from an address by the editor of

Chemical and Metallurgical Engineering, Sidney D. Kirkpatrick, at the Detroit meeting of The Electrochemical Society in 1942.[239] Mr. Kirkpatrick continued:

> It seems that the Wisconsin legislature was on a rampage about that time, and a committee was appointed to investigate this professor who was neglecting his educational duties and had actually accepted $10,000 of tainted money from the vested interests of the Carnegie Steel Trust.
>
> Fortunately Wisconsin then had a truly great Governor—Robert M. LaFollette, the elder—and he made short work of such character assassins by pointing out the great and lasting values that had accrued to the State of Wisconsin as a result of this fundamental research. He might also have lauded the shrewdness of a young instructor who could talk a canny Scot out of that much money to be used for any cause!

Attention should be called to another point made by Mr. Kirkpatrick, when he said, "The Burgess process became the basis for most of the commercial manufacture of electrolytic iron in the United States—but Burgess never made a penny out of it." Burgess did not profit financially from this important line of research because, under the terms of the Carnegie grant, he and his aids were "prohibited from applying for patents or otherwise commercializing the results of the work." This situation, referred to also in Chapter 39, is interesting because it involves a question of public policy. The no-patent condition which made the findings free for public use, *prevented,* or tended to prevent, their being used freely; for manufacturers would not invest large sums of money in methods which were not protected. In a competitive world, what was free for all seemed safe for none. It should be noted that Burgess had not a complete process to offer. Important as his work was, it had been done only on a laboratory scale. Any manufacturer undertaking to produce electrolytic iron commercially would have had to spend further time experimenting with a costly pilot plant; and even then, with the field open to everyone, his competitors might do likewise. So Burgess and his colleagues, estopped from selling their discoveries, had to content themselves with the knowledge of a task well done, and with the not inconsiderable reward of great increase in prestige. Then, as pointed out by O. W. Storey:

> Electrolytic iron began to have a competitor which lessened the need for it, when the American Rolling Mill Co. marketed a pure iron, known as Ingot Iron. This product greatly lessened the need for the electrolytic product, and could be produced in the usual steel furnaces at a price that was discouraging for any producer of electrolytic iron, and Burgess became associated with the Ingot Iron development.

Electrolytic iron refused to die. It might be shelved, it might be side-tracked. But buried—never. At certain times and in certain places it would be needed; sometimes it would be needed urgently. For example, at the time of World War I. The Germans, who had followed with interest the pioneer publications of Burgess and Hambuechen, got an early start. They were manufacturing pure electrolytic iron as early as 1905. *Eleven*

years later, France, in the midst of war, sent Pierre Sauvajol to Madison, to learn from Burgess how to produce pure iron for French war needs. Burgess and his associate Walter B. Schulte conferred with Mr. Sauvajol, who represented a private concern. Then, as Burgess wrote to a friend:

> We described the method for refining electrolytic iron, and placed at his disposal all of the information we had. We learn that this has enabled them to start a commercial production of the material in France, as a means of relieving them, due to the cutting off of the supply of Swedish iron.
>
> We gave this assistance purely as a friendly help, and have no commercial connection with this company. We are, of course, pleased that someone is getting some commercial advantage out of the extensive investigative work which we have done in iron, even though it is a foreign concern.

Sauvajol installed the Burgess process in a plant near Grenoble, and soon notified Burgess that the plant had reached a production of 300 kilos of electrolytic iron a day. At the close of his communication the Frenchman moralizes:

> For you the profit from the affair will be the comfort which the attitude of your grand country has brought to my countrymen and to me in the world crisis.

Virtue once more was its own, and only, reward. In the years following World War I, similar free information was given to inquirers in France, Italy and England. The same generous treatment, involving some expense of money and much expense of time, was accorded American inquirers; not without lasting benefits to the nation.

The widespread interest in electrolytic iron shown at this time gave Burgess the thought that now, at long last, he might be able to revive its manufacture on a commercial basis. In 1919, when the Burgess Laboratories started making and selling chemicals for laboratory purposes, he translated his thought into action. A small unit was installed, operated under the direction of O. W. Storey, and electrolytic iron was produced, particularly as a raw material for ultra-pure laboratory compounds. The outcome was disappointing; customers liked the ultra-pure iron compounds, but not enough to pay the higher cost; they began to say that they could manage to use the cheaper compounds—also made by Burgess Laboratories—and get results that served them well enough. In 1920, when the Laboratories gave up the manufacture of laboratory chemicals, they also stopped producing electrolytic iron.

In a talk on some of Dr. Burgess's contributions to science and industry, Mr. George W. Heise, of the National Carbon Company, said regarding the electrolytic iron research:[238]

> This work . . . had far-reaching consequences. Among other things, it pointed out the remarkable mechanical properties of copper-nickel-iron alloys; it showed the suitability of various iron alloys to use as permanent magnets or as heating elements; it called attention to the remarkable resistance to atmospheric corrosion imparted to iron by small additions of copper, foreshadowing the wide-spread use of copper-bearing steels.

The additions of copper referred to by Mr. Heise *were* small; but the rumpus they raised—if we may again descend to the use of unscholarly language—reverberated long throughout the land. Just as physicians, who once thought that all germs were bad, later found that some germs could be friendly, so did Charles F. Burgess, who had worked hard to rid iron of its impurities, come to the conclusion that some of the impurities were definitely helpful. He was not the sole discoverer of this general truth; but he was among the first to stress the importance of protecting steel from atmospheric corrosion by the addition of small amounts of copper; and for years he had to defend this view against attacks that sometimes almost reached the boiling point. His principal opponent was a prominent chemist of Washington, D. C., Dr. Allerton S. Cushman.

Dr. Cushman, who for some years had been with the U. S. Department of Agriculture, had made a name for himself as a writer on the subject of iron and steel corrosion. He was a prominent supporter of the electrochemical theory of corrosion, a theory upheld in general by Burgess, so that the two men had definite grounds for agreement. Burgess had quoted Dr. Cushman as an authority; this was in a paper read in January 1909 before the Western Society of Engineers.[23] Cushman might have been expected to side with Burgess rather than against him. He was at a disadvantage, however, in that he had not shared Burgess's priceless experience in the study of pure iron, an experience which, as we have seen, involved the production of more than a thousand alloys, each with its special property or use. Furthermore, he led the aggressive side in a controversy with Burgess, when both men were being consulted as experts by the same concern, the American Rolling Mill Company, of Middletown, Ohio. The controversy concerned a product of this company already referred to—the high-grade "pure iron" known as Ingot Iron.

Burgess was acquainted with the merits of Ingot Iron; in 1909 he had used some of it as a raw material for producing his electrolytic iron. He had praised the work done by the American Rolling Mill people toward producing an iron designed to resist corrosion, but he later informed them also of his findings in favor of using a small percentage of copper, which, with only a nominal reduction in "purity", would make the iron unmistakably more weatherproof, that is to say, more resistant to corrosion by the air. As a matter of fact, the Ingot Iron produced in about 1909 and 1910 did contain copper in sufficient amounts to make it highly resistant to atmospheric corrosion.

Because of Burgess's reputation as a corrosion expert, the American Rolling Mill officials invited him to become a consultant, which he did, on a retainer fee basis, in November of 1910. The relationship continued till June 1913, and was the occasion of a continuous battle between Burgess and Cushman, which started when Burgess pointed out that in the Ingot Iron there were traces of copper. This copper had not been discovered by Dr. Cushman; or, stating the case more fairly, it had not been found because it had not been sought. The analysis used had shown only the common impurities which were usually sought, and these were very slight; then the assumption had been made that the balance of the metal was iron; whereas there was an appreciable amount of copper in it. Dr. Cushman

took immediate steps to have the copper eliminated; but the ordinary refining processes employed in the steel furnaces would not eliminate copper, and American Rolling Mill therefore had to limit its sources of supply to raw materials which did not contain copper. The quality of Ingot Iron then dropped, insofar as concerned its fitness to resist atmospheric corrosion.

The Burgess-Cushman dispute was an "inside" battle until Burgess resigned as consultant in 1913. By that time members of the entire steel industry were entering the controversy, which raged on for several years, with Dr. Cushman denouncing the use of copper and sometimes impugning the motives of those who advocated its use. The situation was unfortunate. Ingot Iron, the product under discussion, was an admirable product; Burgess simply insisted that it would be better still if reinforced with less than a few tenths of one percent of copper.

Trouble was caused by advertising claims which were sometimes based on varied interpretations of available data; also by the fact that some participants in the dispute were slow to recognize that steel corrodes variously when exposed under varied conditions. As to the last-named point it may be enough here to mention, in the words of O. W. Storey, that "corrosion in the atmosphere is entirely different from corrosion in water, either salt or fresh, or in acids. A steel that may be resistant to corrosion in the atmosphere may not stand up well in water or in acids."

As to advertising claims, so much had been said, under Cushman's influence, about the undesirability of copper in steel, that the claim of freedom from copper seemed to be a "must"; this in spite of the fact that Burgess had clearly shown that the high corrosion resistance of the Ingot Iron as originally produced was largely due to the presence of copper. The other difficulty mentioned, concerning varied interpretations of the same data, appeared in the case of the famous links of the old chain suspension bridge at Newburyport, Mass. When John Finley, pioneer American bridge-builder, spanned the brackish tidewaters of the Merrimac in 1810, he spanned them so well that his bridge lasted for 99 years. Many of its forged iron links, reportedly not painted since 1839, were still in good condition at the time of the rebuilding in 1909, when they were hailed as "a fine example of the resistance to corrosion of old wrought iron." American metallurgists were eager to obtain samples of these links for experimental purposes, to learn the secret of their freedom from corrosion. Professor Burgess at Wisconsin had many microscopic samples made from the links; in this work he was assisted by Instructor James Aston, who made numerous microphotographs. As the result of these researches, it was found that the iron in the links was by no means pure; it was a typical old-style wrought iron, and consisted of "a mixture of all kinds of iron and steel intermingled with much slag, with here and there some small patches of very pure iron." An observer of the controversy has made the following comments:

> The importance of the slag was overlooked by many investigators, and particularly by Cushman. C. F., however, did not overlook its importance, and he pointed out that the overlooked slag played an important part in protecting many of the old wrought irons.

> . . . The slag layers in the wrought iron and even present in some steels often formed protective coatings or barriers which stopped the rusting action.
>
> Some years later C. F. got a patent[116] on a method for protecting iron based on these observations. He formed a layer of resisting metal, such as nickel, near the surface of iron and steel as by electro-plating, and then when the corrosion pits formed in the surface of the iron or steel these were stopped by the presence of the corrosion-resistant metal.

Burgess resigned partly because while receiving a retainer fee he did not feel free to publish views contrary to those adopted by his clients, and partly because, he claimed, the supporters of the "100% pure" theory used *his* pictures to support *their* claims, publishing only the photographs which showed the small areas of pure iron, and suppressing those which showed the mixtures. Then they claimed that their iron resisted corrosion because, like the iron in the Newburyport Bridge links, it was free from harmful impurities.

Much of the iron ore mined prior to 1884 came from eastern regions and other countries and contained small quantities of copper. It was made into sturdy sheet-iron, fence wire, and the like, and braved exposure to the air for many years, *protected* by its own peculiar rust. This rust was close-grained, tough and adherent; so Nature formed a good protective coating. When in 1884, the great Minnesota deposits were opened up, America began to be supplied with iron ore containing no copper, and in the course of time people began to complain that their fence wire, sheet steel, rails and other objects exposed to the air, were rusting away much faster "than those made in the good old-fashioned way."[298] Not realizing the change in raw material, they blamed modern methods. The new kind of rust was not the protective kind; loose and flaky, it fell off, scale by scale, till nothing was left. The strange behavior of the new iron was a mystery until Burgess[25] and others—notably Daniel M. Buck[299]—began to preach the gospel of copper-in-steel; then, by telling the truth, Burgess got himself into oceans of hot water, as in the famous Burgess-Cushman case.

Seen through the mellowing light of years that have passed, the controversy loses some of its excitement; today such a controversy would hardly be possible, for, as his friend Howard F. Weiss said in 1932,[248] when Burgess received the Perkin Medal Award:

> The addition of a small amount of copper to iron makes it much more resistant to atmospheric corrosion . . . Dr. Burgess's position has been substantiated by the test of time.

It has been substantiated also in a more specific way. When the American Society for Testing Materials made a series of tests to determine the comparative atmospheric corrosion rates of various types of irons and steels used for steel sheets, the stand taken by Burgess and Buck was completely vindicated. Degrees of resistance revealed by the tests, which lasted over a period of many years, may be graded as follows, starting with the best:

a. Ordinary steel with copper
b. Ingot Iron with copper
c. Ingot Iron without copper
d. Ordinary steel without copper

Burgess never lost his interest in iron and steel and their alloys. Toward the close of his life on earth he often discussed plans for producing electrolytic iron again, and having "fun"—a word he often used—with new research and new discoveries. But he had so many other "irons" in the fire; and one man simply can't do everything. His place in iron and steel history is suggested by an entry in the book, *Metallurgy and its Influence on Modern Progress,* written by his loyal friend Sir Robert Hadfield. There the name of Charles F. Burgess appears in a list of the most famous scientists, physicists, chemists and engineers of the day. Praise from Sir Robert was praise indeed.

14.

Early Industrial and Wisconsin Railroad Commission Work 1901-1909

"MR. VAN WINKLE sent me his check for $25.00 without any question. That is I believe my first outside work since we were married, and may be simply the beginning of many of them." So wrote Burgess to his wife, one summer day in 1904, when she was visiting his parents in Oshkosh. The gentleman who paid without any question was Abraham Van Winkle, of the Hanson & Van Winkle Co., manufacturers of platers' supplies, a concern with which Burgess had had pleasant relations for several years. The $25.00 seemed important, for the nation was going through one of the recessions which followed the Spanish-American War, and business men—the four Johnsons, for example—were spending as little as possible. Charles and Ida Burgess were having the trying but useful experience of being forced to watch their pennies. Hence the importance, in 1904, of even moderate additions to their income.

In his capacity as consultant, Professor Burgess was faced with projects varying in nature, duration and importance. These ranged all the way from a few hours spent in checking the efficiency of a dubious electromedical device, to periods of months or years devoted to studying broad problems in chemistry and engineering. The word "Professor" is here used designedly; it recalls the fact that during many of his consulting years, Burgess was a member of the faculty of the University of Wisconsin, and might be open to the criticism that in accepting "outside" work he was serving two masters. As a matter of fact, he was; and, as he once wrote to his father, "This attempting to serve several masters at once is certainly strenuous." It was, however, a recognized practice in University circles, for reasons both economic and educational. Many of the best teachers were men qualified to fill useful positions in industry, at salaries which made the instructor's or professor's pay seem very unattractive. The only way to keep such men on the faculty was to permit them to engage in so-called outside work, which usually meant serving as experts or consultants. As a rule the work was not as "outside" as it seemed, for the subject in which a man was expert was likely to be the subject he was teaching every day; so that while his university experience doubtless helped

his clients, his little journeys into business often enriched him with practical viewpoints with which to help his students. So generally was the theory of extra-scholastic remuneration accepted, that when one university tried to hire a professor away from another, or from an industrial concern, the offer, after naming a salary, often added some such phrase as "There will be opportunities for lucrative outside work."

We have several times talked about the electrolytic rectifier, which had seemed a likely source of handsome profits; but we have also noticed that in September 1903, when Burgess discussed this device, he mentioned the possibility of "considerable expense for patent litigation." Such litigation was indeed encountered, and the outcome for Burgess was disappointing. Told with all its detail and all its drama, the aluminum rectifier story would fill a fair-sized book. Here we can only give an outline, starting about 1899 with Burgess's first thoughts about an invention for converting alternating into direct current. Plenty of machinery existed for doing this on a large scale, but the urgent need was for a convenient means for doing it with small installations. There had been a phenomenal growth in the use of storage batteries, notably in electric automobiles and boats. Virtually every car or boat owner could use a small rectifier, if one were available, so as to be able to charge his storage batteries at home.

By 1901 some progress was made, and, as we have already learned, Burgess put Carl Hambuechen to work on the device, on a fifty-fifty profit-sharing basis. Hambuechen made at least one fundamental discovery, relating to the use of a fused electrolyte, and earned his advanced degree of Electrical Engineer in June 1901 with a thesis on "The Aluminum Cell as a Rectifier of Alternating Currents."[257] At the April 1902 meeting of the American Electrochemical Society, Burgess read the Burgess-Hambuechen paper on "The Electrolytic Rectifier,"[53] thus giving the device considerable publicity. This publicity, extending into scientific journals and into the pages of *Popular Mechanics* magazine, was premature; it prevented the getting of valid foreign patents, and probably gave strategic information to rival inventors. In 1903 four patents were applied for, by Burgess, Hambuechen, and the two jointly, and three of these were granted; but late in the year Burgess was faced with trouble when no less than four other men claimed the same invention. They were William B. Churcher, of Cincinnati, Percy H. Thomas, chief engineer of the Cooper-Hewitt Co., Ezechiel Weintraub and Charles P. Steinmetz. Dr. Weintraub was in the research laboratory of the General Electric Company, and Steinmetz was that company's world-famed consulting engineer. Burgess was honored by the prestige of his rivals.

We have pointed out that three out of four patent applications were granted. This might seem fairly satisfactory but for the fact that the fourth, not granted, was the most important. It covered an electrical circuit for connecting not only the Burgess rectifier but rectifiers of other types, such as those used by Churcher, Thomas, Weintraub and Steinmetz. Unfortunately for Burgess, these men, discovering how to make the same circuit, applied for patents at about the same time as Burgess.

Late in 1904 victory seemed to be in sight for Burgess, when the Patent Office found him to be the prior inventor and therefore en-

Mrs. Burgess with Betty and Jack—1908

titled to receive a patent. Then the General Electric Company offered to buy the invention, but Burgess refused the amount they offered. It is interesting to note that the offer was made by Burgess's former student and colleague, Arba B. Marvin, then assistant manager of General Electric's patent department. When Burgess refused to sell, Marvin made an intensive search of the technical literature to see if someone else had disclosed the circuit in a publication early enough to invalidate Burgess's allowed patent claims. Marvin's search was rewarded when he found that the circuit had indeed been described in an obscure foreign scientific journal early in 1901.[289] The claims were then disallowed by the Patent Office.

Burgess, in common with many another inventor, had delayed too long in the filing of his patent application. Unquestionably he was the first inventor, having conceived the invention as early as February 27, 1899, when he made a drawing of it. He tried it out successfully two years later, in February 1901. But he did not file his patent application till March 1903 which was too late, for that was a few weeks beyond the end of the then statutory two-year period after the disclosing publication had been received in the United States. In the Patent Office, the difference between success and failure is often measured by days, or even by hours.

On the credit side of the rectifier story it should be stated that one of Burgess's four patents seems to have had a sort of surrender value, if we may judge from the fact that in 1906 the General Electric Company bought it for $1,000.

When he began to realize that his dreams about the rectifier were unlikely to come true, Burgess recalled a remark made by his wife a short time before their marriage. "Charles," she had said, "I don't want you to be very successful *all at once.*" Ida knew the uses of adversity.

In July 1905, when Burgess received the full title of Professor, his university salary was set at $2250, a raise of $450. Business in general was on the upturn, and there was some improvement in what he could earn from consulting work. This did not mean, however, that the Burgess household was going to be overburdened with money, for as the income increased, so did the outgo—and for very proper reasons. One of these proper reasons appeared on Sunday, September 3, 1905, when Ida presented her husband with a baby girl, who was promptly christened Betty, and whose presence, visible and audible, soon loomed large in the routine of the little apartment at 209 West Gilman.

The aforesaid apartment was above a similar one occupied by Dr. and Mrs. A. P. Wilder. For some years Dr. Wilder had been connected with the *Wisconsin State Journal,* but he was preparing to move with his family all the way to China, to serve as American consul-general at Hong Kong. One day Mrs. Burgess, upstairs, telephoned Mrs. Wilder, downstairs, and asked if they could take a walk together. "I just can't go out," said Mrs. Wilder. "I can't leave the children." "Chloroform them," quipped Ida. Her remark gained as much celebrity in Madison as a similar alleged remark of Dr. William Osler once gained throughout the world. If Isabel Wilder had taken Ida Burgess's advice seriously, her lit-

The Tenney home (1948 picture)—the House on the Hill where the marriage took place—524 Highland Avenue, Madison, Wisconsin

tle boy Thornton might not have grown up to write *The Bridge of San Luis Rey.*

Wilders and Burgesses both moved from West Gilman Street in 1906. The Wilders went to China, the Burgesses a much shorter distance, to 1601 Adams Street, in the area of Madison known as Wingra Park. Burgess bought this house, and the little family occupied it for about five years.

Burgess received a number of tempting offers, both educational and commercial; and some of his colleagues, aware of his deep-rooted desire for material success, wondered why he stayed on for years at Wisconsin where, in spite of favorable conditions, they told one another "He'll never get rich." Perhaps they did not perceive in their friend's mental make-up a blend of impatience and patience—of ambition to succeed, tempered by prudent consideration of the steps leading to success. Perhaps, too, they overlooked the fact that Burgess sincerely liked teaching, not merely as a means of earning a livelihood, but as a means of service to others. He took a more than academic interest in his students, and they in turn had high regard for him. Many of them, profiting from his helpful and practical teaching methods, are prominent in the scientific and industrial world today. And, coming back to our original point, Burgess's notable work in education during these years was aided by the fact that he was free to engage in outside research and consultation.

One of Burgess's earliest ventures as an independent consultant was taken in the summer of 1902, when he went to Beloit, Wisconsin, at the behest of the Beloit Water, Gas & Electric Co. The problem there was one of "stray-current electrolysis"; some of the company's water pipes were showing signs of corrosion, supposedly caused by leaking street-car current which returned to the power house by way of the water pipes instead of by way of the rails. Burgess was called upon to determine the nature of the damage, and to devise some means of preventing its recurrence. Presumably his services were satisfactory. At the University he had worked on electrolysis under a specialist in that field, Professor D. C. Jackson. In Beloit he brought to the task his own knack of quickly tracing the pathway between cause and effect. He soon earned a reputation for solving problems by simple and inexpensive means; and in later years he was much in demand as an expert in this type of electrolysis. This was especially true from 1907 on, when Professor Jackson left Wisconsin and went to the Massachusettts Institute of Technology. Burgess undoubtedly fell heir to projects which would otherwise have gone to Jackson. His aid in solving electrolysis and other problems was enlisted by utility companies in the middle west and as far away as Pennsylvania and Texas. He served the Peoples Gas Light and Coke Company of Chicago as a consultant for many years. As to his work for the utilities in Wisconsin, this was done largely as a service to the Wisconsin Railroad Commission, of which he was a member for over six years, commencing with October 1907.

During 1905 and through 1907 Burgess did a good deal of work on the reduction of zinc ore to metallic zinc, particularly by means of the

electric furnace. As a result of this work, in which he was helped by Otto Kowalke, he received a patent.[113]

In June 1907 he got away from the University about two weeks before commencement, and took his wife and baby daughter to Rumford, Maine, where they enjoyed a pleasant vacation. He doubtless had a good time himself, but it was a very busy time, for he was in Rumford for the summer to serve as consulting engineer to the Oxford Paper Company. This project called for development of a new type of mercury electrolytic cell devised by Jasper Whiting for the production of chlorine and caustic soda from common salt, and for aid in designing a new electrolytic plant utilizing this cell.[262] The chlorine so produced was used to make bleaching powder or "bleach" which in turn was used for bleaching the paper pulp. Burgess studied this process carefully, and made a number of improvements.[106] In the course of this work he visited many electrolytic and bleach plants and obtained valuable information. Research and consulting service for this client and others in the same line continued for many years and earned for the Wisconsin professor a place among the electrolytic chlorine and caustic bleach-making experts of the world.

Forty years later, in one of their widely-quoted trade paper advertisements, the Oxford Paper Company used the words "Laboratory research plays a vital part." Burgess would have liked that phrase; it would have reminded him of one of his early successes in *applied* electrochemistry.

A student of paper-making history has pointed out that Burgess gained his first experience in this industry at the virtual birthplace of the electrolytic alkali-chlorine cell. The basis for this statement is the fact that Rumford, Maine, was the scene in 1893 of the first large-scale installation of the caustic soda-chlorine electrolytic cells invented by the Canadian expert, Ernest A. LeSueur.[261] The cells were not of the same type as those on which Burgess worked, but it may be noted as a coincidence that the name of another Burgess was involved, for LeSueur had been helped financially by the Burgess Sulphite Fibre Company; and it would be interesting to know if this company was connected with the firm of Watt & Burgess in England, who as far back as 1854 had obtained a patent on a soda pulp for the manufacture of white paper.

Another line of research undertaken at about this time, and carried out in the electrochemical laboratories of the University, concerned some of the special types of corrosion occurring in locomotive boilers. The problem was brought to Burgess by a former Wisconsin student, Walter Alexander '97, of the Chicago, Milwaukee & St. Paul Railway Company. Part of Burgess's presidential address before the American Electrochemical Society in April 1908[6] was devoted to his observations on boiler corrosion, based on investigations made for the railway company; and in January 1909, at a Chicago meeting of the Western Society of Engineers, he amplified his treatment of the problem in a paper entitled "Boiler Corrosion as an Electrochemical Action,"[23] and suggested lines of research for a possible cure. Present at the meeting was a noted electrical engineer, R. F. Schuchardt '97, of the Chicago Edison Company, who moved a vote

of thanks to the speaker, paid a tribute to his alma mater, and spoke of the increasing use of iron. Mr. Schuchardt said in part:

> It is fortunate that our leading universities can and will permit men of the caliber of Professor Burgess to devote their time and energy to problems of such tremendous commercial importance.
>
> The present day is often called the "Age of Iron." The amount of this metal used in a single month at the present time is more, I believe, than was used in the entire century before 1850. It is this extensive use of iron which is making the progress of civilization at the present time more rapid than at any other time in the history of man.

The "problems of tremendous commercial importance," of which Mr. Schuchardt spoke, were equally problems of *social* importance. Society is a human body; touch it at one point and you touch it all. Sometimes this truth is not apparent; the man in the street knows or cares little about the digestive troubles of a locomotive boiler. But sometimes it is dramatically apparent; the man in the street, or more likely his wife, is immensely interested in the amount of the monthly gas bill. And here again we come right back to Burgess. In June 1907, his father had written to him:

> The last I have seen with reference to that "Utilities Bill" was that it had passed both houses and needed only the Governor's signature to become a law.
>
> I do not understand what there is in it for you, or why you should be interested in it. If there is anything in it to promote your welfare or add to your aggrandizement, I am ready to throw up my hat and *hoot*. Please explain.

The Wisconsin Public Utilities Law, initiated by the elder LaFollette, and now duly signed by his successor, Governor James O. Davidson, dealt with all gas, electric, water, telephone and heating plants in the state. It promptly placed the regulation of such plants in the hands of an agency already functioning, the Wisconsin Railroad Commission, which thus inherited many duties not suggested by its name. Some time in September 1907 the Commission announced the appointment on its engineering staff of Professor Charles F. Burgess, of the University of Wisconsin, as its expert on light and heat. The appointment became effective October 1st. There *was* something in it for Burgess, as his father had hoped; a moderate salary, some useful experience, and, in his own words, "Close contact with prominent engineers, lawyers, politicians, etc." But there was also a great deal of work to do; and the records show that Burgess lost no time in getting started. His task was "to establish standards for gas and electric service in the State of Wisconsin." With this end in view, he made intensive studies of gas and electric plants throughout the state, and found wide variations, not only in service to the public, but in efficiency of operation.

Gas, he held, was used largely under conditions which dictated that its service value should be based on its heating value; in place of the candle-power standard he advised adoption of a calorific standard. Ideal

service, under average home conditions, would be best served by a gas with about 600 British Thermal Units per cubic foot. But tests made throughout the State showed heating values ranging in BTU's all the way from 193 to 1050. Standardization seemed likely to be helpful to buyer and seller alike. Thirteen rules were made for gas service, the principal rule being that requiring standardization of heat-value. Rules prescribed for plants selling electric service were somewhat more flexible than those dealing with gas, because, as stated in the Commission's report, "it is obviously desirable that rules shall not be adopted which will interfere with the natural growth of the industry." This is probably one of Burgess's own phrases.

That there was no interference with natural growth in either industry, gas or electric, may be inferred from the fact that within a year after the Commission's requirements had been met, the gas utilities increased their net earnings 7.4 per cent, and the electric utilities increased theirs 25 per cent. As to the heat-value basis for the sale of gas, it was in due time adopted universally, and Burgess was proud to have helped Wisconsin show the way. [77, 79] He insisted that he had only helped, and often pointed out that in his work for the Commission he received valuable aid from others. The part he played personally can be stated in the words of a man who from 1906 to 1913 was the Commission's Chief Engineer, the late William D. Pence. In a memorandum penned by him several years ago, Mr. Pence said:

> C. F. Burgess served through the formative period under the Public Utilities Law as administrative "Expert on light and heat." He conducted the investigations and conferences through which the Wisconsin "Standards for Gas and Electric Service" were pioneered, and was chiefly responsible for drafting Order No. U-21 as adopted by the Wisconsin Railroad Commission on July 24, 1908.

Professor O. L. Kowalke credits the early success of utility regulation in Wisconsin largely to Burgess. The Commission had been initiated by Governor LaFollette over the bitter opposition of railroads and utilities, and the outcome depended upon the men entrusted with formulating the basic rules and policies. Professor Kowalke points out that the successful operation of the Commission from its beginning was in marked contrast to the indifferent success that attended similar efforts in many other states. Burgess was trusted, not only by the men who headed the Commission, but by the men in the utilities that were regulated. Because he recognized their problems, the rules and regulations he prescribed were reasonable, and not mere edicts of a bureaucrat.

Burgess's work for the Commission brought him some extra money—just in time to meet an extra expense, represented by the birth of a son, on December 1, 1907. Like his father and his sister Betty, the little boy arrived on a Sunday. When he was given the name Jackson, some of the University people naturally assumed that it was a tribute to Professor Dugald C. Jackson, lately departed for Massachusetts; but intimates of the

family knew that the boy had been given his mother's family name. At all events, the name was doubly fitting.

Burgess once said that he became an expert in light and heat "by legislative action rather than by qualification." This was his way of saying that he knew less at the beginning of the research than at its end. According to Webster, "expert" (Latin *experiri, to try*) means "knowing and ready, from much practice"; and in this sense Burgess was expert all the way through. At any rate, he was soon much sought after in gas and electric circles. Less than six months after taking up work with the Commission, he was the principal figure at a big meeting at Madison, where he met 200 representatives of gas and electric companies from all over the map; and among those present was a man from the Bureau of Standards in Washington. In October he appeared in New York before the American Gas Institute, and shortly afterwards he was placed on its Calorimetry Committee. In Boston, the chairman of the Massachusetts Gas & Electric Commission was glad to spend an afternoon with him. At the State Capitol in Albany he conferred with leading men of the New York Commission. "They treated me finely," he wrote to his father, "and with all due respect, and my work for Wisconsin is benefited by this experience." It was a typical Burgess reaction; pride of personal achievement, tempered by a sense of responsibility to the State.

Burgess often rendered professional services worth a good deal more than the fees he received. For example, when dealing with clients in the State of Wisconsin, he made a point of charging low fees, on the theory that much of his work was done at a university supported by Wisconsin taxpayers. To some clients he made no charge; this was often the case when, after spending considerable time on their problems, he felt that he had not been helpful. Sometimes, on the other hand, he found difficulty in collecting even when he had given worthwhile assistance. It has been said that his satisfaction came in larger measure from the research than from the reward. Often, approached by total strangers, he would give valuable technical information without asking any payment at all.

One day in August 1909, when he was busy with a dozen exacting projects, the postman brought him a bulky envelope. It contained a few ounces of some powdery "stuff," and a simple letter from a man who said he had found said stuff on his land, and would be glad to have a report on its nature and possible commercial value. The man, evidently quite a spender, added, "I enclose a stamped envelope." Burgess replied courteously, named the probable ingredients, suggested a possible use for the "stuff," and gave some advice as to where it might be offered for sale. All he got out of it was the pleasure of examining something and of helping somebody. This sort of thing happened at odd intervals throughout his career; no dollars, no cents, no regrets. Here, at the end of a chapter full of triumphs, the story might seem to come as an anti-climax. It will not seem so to those who knew Charles F. Burgess best.

15.

Establishing the Applied Electrochemistry Course at Wisconsin

CHARLES F. BURGESS's years at the University of Wisconsin were years of destiny. They comprised almost a third of his time on earth, and they influenced greatly the course of his entire adult life. We have already seen how he went to Madison in 1891, attracted by the course in electrical engineering then being organized by Professor Dugald C. Jackson; and we have learned how, after his graduation, he was given an opportunity to help Professor Jackson build up a course in electrochemistry. In order to give some completeness to the University story, let us look back at the years before 1891, and ask if any electrical engineering was taught at Wisconsin before Professor Jackson came on the scene. The answer to our question is "Yes." In the Fall of 1888, two students registered for an electrical engineering course; they were Edwin T. Munger, of Menominee, Michigan, and Frederick H. Ford, of Waupun, Wisconsin. Munger made history by being Wisconsin's first electrical engineering graduate; he received his B.E.E. in 1892. Ford graduated in 1893, along with two others, also B. E. E. The degree Bachelor of Electrical Engineering was then discontinued, only four graduates having received it. In the Fall of 1889, six students registered for electrical engineering, and H. A. Lardner, who started in mechanical engineering, seems to have joined them later, for in 1893 he graduated B. S. (E. E.). In 1890 eleven students registered for electrical engineering. They and their predecessors make a total of twenty, most of whom graduated.

Up to this point, the course had been conducted largely by Dr. John E. Davies, a man of profound learning, especially in the fields of mathematics and physics. Keenly interested in electricity, Professor Davies had begun as early as 1870 to collect an electrical outfit of the best kind then available, including one of the earliest Gramme dynamos built in America. In 1884, when this equipment was destroyed in the fire that wiped out old Science Hall, the loss came as a severe blow to the professor, for his physics department had been expected to give such instruction in electricity as was deemed necessary, and the equipment, though meager by present day standards, took several years to replace. Although, as will be seen later, Professor Davies was a genial, friendly man, always ready to help an individual student, his style of classroom instruction was somewhat academic. In 1891 a University publication said of him "Having

studied for years, he is naturally more interested in the higher and mathematical department of physics than in purely elementary instruction."

Then it was that President Chamberlin, who had taken office in 1887, decided to create a separate department of electrical engineering, under Dugald C. Jackson, a teacher chosen for his eminently practical background. The move caused some lifting of eyebrows in conservative quarters; but Thomas Chrowder Chamberlin was not abashed. This would not be the first change he had made. On coming to Wisconsin, he had found engineering and agriculture treated as "mere adjuncts to the study of liberal arts." He had set them on their own feet as properly organized colleges. Having raised departments to the dignity of colleges, he considered it useful to raise some courses to the dignity of departments. These forward steps were in line with his unfaltering belief in the importance of applied science. It was in this fortunate atmosphere—new, progressive and energetic—that Burgess, in the Fall of 1891, entered upon his university career.

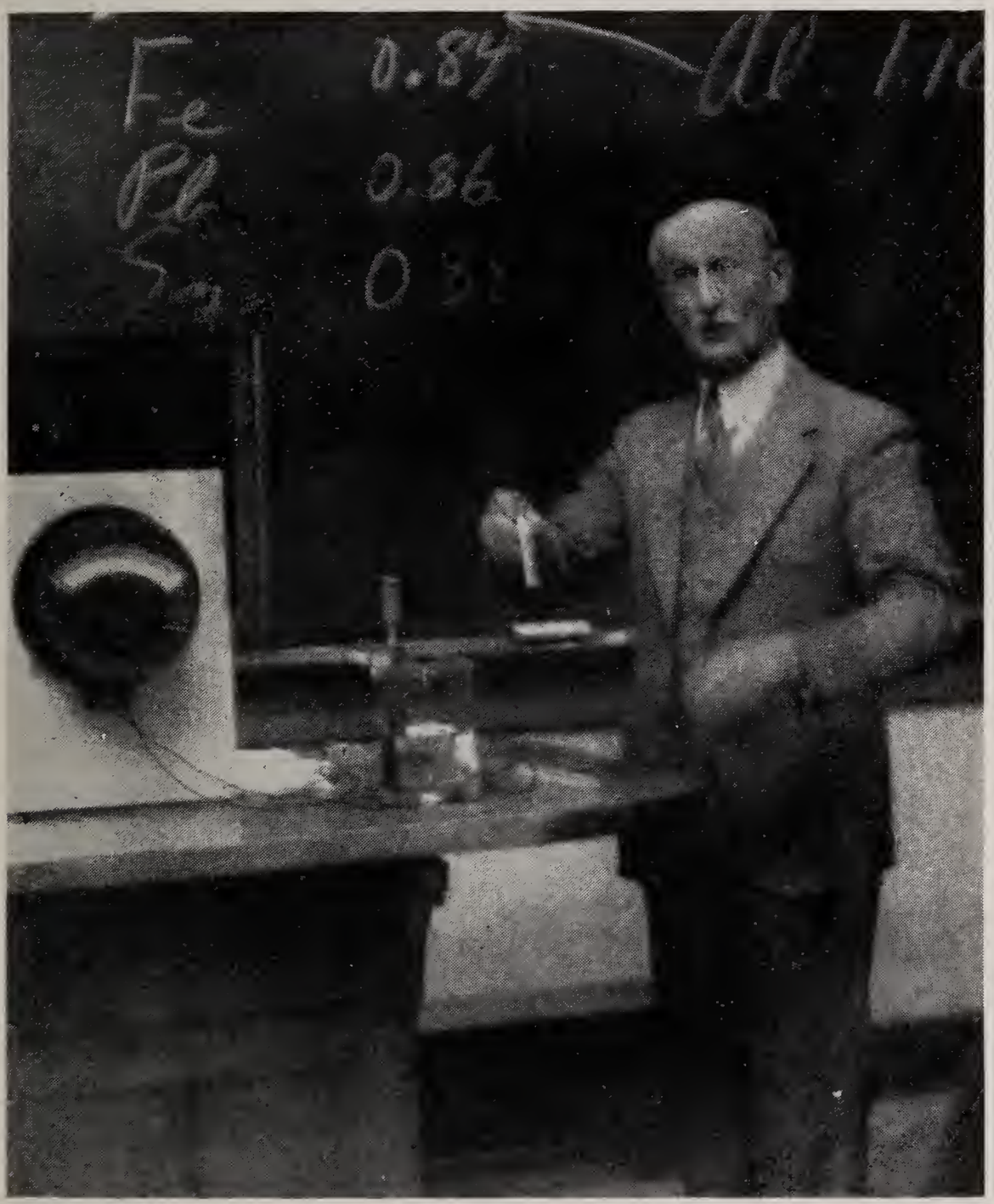
In Professor Jackson, Burgess recognized a man willing to make bold departures from "the established order of things." Years later, when asked about Jackson's Wisconsin period, Burgess wrote:

> He was an interloper in the educational field. The Physics Department thought that it was amply qualified to teach the young people all that they ought to know about electricity; the Civil Engineering and even the more modern Mechanical Engineering Department held that they were qualified to deal with engineering requirements. But D. C. Jackson thought otherwise. He saw that, related to the electrical phenomena, was a field of opportunity not even dreamed of by his predecessors.

In fairness to the predecessors, it should be stated that they could not know as much about the "field of opportunity" as Jackson. They had not been in it. He had. He had been in it for eight years, and part of the time with Edison. Opportunities had been "popping" all around him; and instead of grasping at them for himself, he unselfishly devoted his life to telling others about them. The word "telling" is used advisedly; in Professor Jackson's early months at Wisconsin he had to get along with a minimum of equipment with which to illustrate his good tidings. As Burgess remembered it:

> The dynamo laboratory equipment consisted of a homemade electrical generator connected to the line shaft of the machine shop. Little money was available for additions to the equipment. But by mysterious talents (which I suspect included ability to beg or borrow for undetermined periods from the electrical manufacturers of the country), his laboratory plant became larger and more respectable. So limited was the number of ammeters and voltmeters that the earliest laboratory classes had to be divided into sections, some of which were operated at night. It was always a sad night when an electrical instrument was burned out by careless use.

An important piece of equipment "borrowed for an undeterminate



Dr. Louis Kahlenberg during the last lecture he gave to his students at University of Wisconsin

period" was one of Edison's early dynamos, perhaps his earliest. It was brought to the laboratory after being shown at the 1893 World's Fair in Chicago, and was said to be the historic first Edison dynamo which had delighted Sarah Bernhardt when she made a midnight trip to Menlo Park in 1880, the year it was built. According to an article in the *Western Electrician,*[304] the dynamo served Wisconsin efficiently for many years.

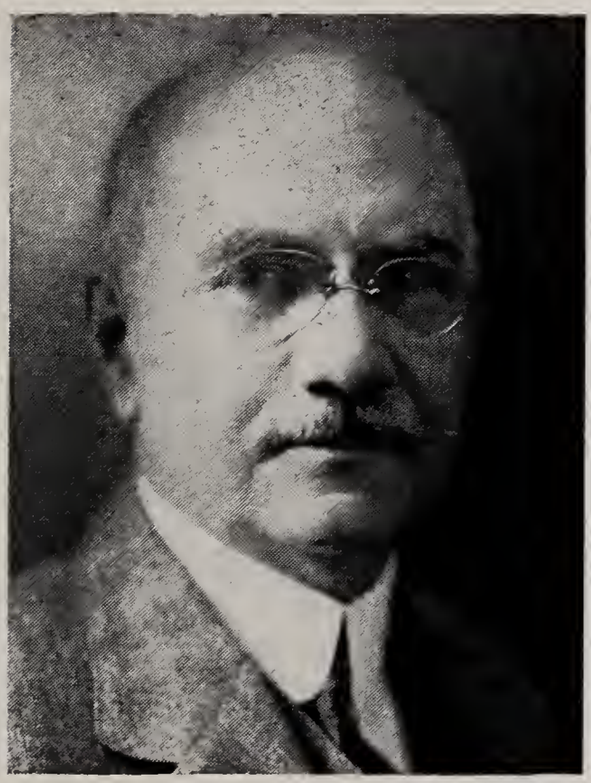
If some inquiring genius had installed a seismograph in the old electrochemistry laboratory, his charts would have recorded an almost endless succession of quakes, due not to normal tremors of the earth, but to vibration from the machine-shop down below. Necessary line-shafting was attached to the ceiling of the machine-shop, and the ceiling was virtually continuous with the floor of the laboratory. So, in the words of a former student, "the instruments used in the electrochemistry laboratory suffered from this vibration, and interfered with the quality of the work that was done there."

Two men—the practical Professor Jackson and the academic Doctor Davies—made up the teaching staff of the new Electrical Engineering Department. Doctor Davies co-operated by conducting the single course in applied electrochemistry. This course was divided into two subjects, (a) Primary and secondary batteries; (b) Electrolysis and electrometallurgy. Burgess's interest in the primary cell was due largely to his conscientious teacher, of whom he later said:

> Doctor Davies had a wonderful influence on me—not because of his mathemathical ability, but because he took a friendly interest in me and invited me to his home.
>
> He asked me to work out some simple electrochemical problems—using Carhart's *Primary Batteries* as a textbook; and this led me to haunt the library looking for more electrochemical literature, then very scarce.

The Carhart book, along with Niblett's *Secondary Batteries* and Gore's *Electrolytic Separation of Metals,* were used in the school year 1892-3, and for several years following. In the Fall of 1894, Burgess's friend Samuel B. Fortenbaugh, just appointed assistant professor, was assigned to teach the applied electrochemistry course, along the same lines as before, and with the same barely adequate laboratory equipment. In some other phases of the Electrical Engineering work, Professor Jackson was now assisted by Instructor John G. D. Mack. "Johnny Mack," as he was to be affectionately known through many years of service at Wisconsin, became one of Burgess's most valued and inspiring friends.

We learned in Chapter Two how Fortenbaugh and Burgess spent their 1895 summer vacation working in Cleveland; and how Professor Jackson instructed them to plan the laboratory equipment for what was to become Wisconsin's first modern course in applied electrochemistry, in which Burgess, as assistant in electrical engineering, was to get his first opportunity as a teacher. The instructional staff of the electrical engineering department now numbered



Bachrach

Professor Dugald C. Jackson

four; Professor Jackson, assistant professor S. B. Fortenbaugh, instructors C. F. Burgess and Arthur H. Ford, the last-named two having just graduated with their B. S. (E.E.). The applied electrochemistry subjects, with the same textbooks as previously, were now taught by Fortenbaugh, Ford and Burgess. It is interesting to note that Burgess was not yet handling the subject of batteries. Fortenbaugh and Burgess also taught a course of study in electromagnets and dynamos. Burgess was impressed by the fact that for this course they used a textbook written by the head of their own department; it was Volume One of D. C. Jackson's *Electricity and Magnetism and the Construction of Dynamos,* which had appeared in 1893.

Burgess's first promotion came in 1896, when he was raised from "assistant" to "instructor" in electrical engineering. With the change of title came added responsibility; Burgess alone taught the section dealing with electrolysis and electrometallurgy; he alone taught a new course entitled Electric Light and Transmission of Power. He shared with Fortenbaugh the section dealing with primary and secondary batteries, but no longer taught electromagnetism and the construction of dynamos. Joining the staff as assistant was a classmate and close friend, Budd D. Frankenfield. A contemporary reference mentions *five* teachers, and in all probability the fifth was Arthur H. Ford, who by 1896 was listed at Wisconsin as a Fellow in Electrical Engineering. All of these men were kept busy, for the Electrical Engineering Department had grown apace; by the school year 1895-1896 it was serving 110 students.

Although "only an instructor," and likely to remain an instructor for several years longer, Burgess was not afraid to take initiative. Under the friendly eye of Professor D. C. Jackson he was given many opportunities to do things in his own way, which usually turned out to be the way of progress. Some idea of what he accomplished even in his first teaching year may be gained by studying the 1896-1897 catalog,* where we are told that the electrical engineering laboratory facilities have been expanded to include:

> . . . . another large room which contains apparatus and appliances for instruction and experiments in electric batteries, electrolysis, electroplating and electro metallurgy; dynamos, tanks for depositing metals and for other electrolytic processes; apparatus for cleaning, polishing and burnishing; three electric furnaces for electrometallurgical processes requiring the intense heat of the electric arc, and proper measuring instruments. The equipment is one of the first and most complete of its kind.

While not all the equipment so eloquently described—probably in Burgess's own words—was there because of his unaided efforts, much of it was; and some of it, in the opinion of O. W. Storey '10, was built by Burgess himself, or under his direction by his students. Mr. Storey has pointed out that the appropriations in the Nineties were

* See also C. F. Burgess's article in *Western Electrician,* Vol. 20, p. 157 (1897), "Electrolysis Equipment at the University of Wisconsin."[64]

small, and that some of the items used by Burgess, such as his special electric furnaces, were not even on the market. A prize possession at about this time was the Moissan electric arc furnace which Burgess had obtained from France, and which in later years was exhibited in the Chemical Engineering Building as a historical relic. Some of the equipment acquired in 1896 bore the name of Chester H. Thordarson, who later on became one of Burgess's most valued friends. The Thordarson Electric Manufacturing Co. had been organized in 1895, so that Burgess, for the University of Wisconsin, became one of its earliest customers.

Another good friend was Dr. Louis Kahlenberg, from whom at about this time Burgess began to take special instruction in chemistry. Kahlenberg, who taught at Wisconsin for forty years, and had an excellent knowledge of the theoretical aspects of electrochemistry, did much to help Burgess in his studies. Some years later the two men were to go through a period of dissension and rivalry, but their relations at this time were peaceable enough.

In March 1897 a letter came to Burgess from the office of the Board of Regents informing him of his appointment to have "general charge of the operating machinery of the elevators at Ladies' Hall." He was "to make frequent and careful investigation of same, and report any need of repair. . .and this shall be one of his duties without extra compensation." Now, in an academic sense at least, he was an elevator man. He doubtless accepted the new task with a smile, as one more proof of the importance of *applied* science.

In the Fall of 1897, Murray C. Beebe '97 joined the teaching staff of the electrical engineering department. Burgess continued to teach the course in electric light and transmission of power; and, as he pointed out in a letter written at this time, he was in charge of "all the work in applied electrochemistry." He sometimes spoke of 1897 as being the year in which "the course" in electrochemistry was first offered; at any rate, he felt that the course offered in this year was more nearly complete than any which had preceded it. In the catalog for 1897-8, Burgess is listed as having graduate work under his supervision.

1898, the year that brought Burgess his 25th birthday, brought him also some reasons for deep satisfaction, not to say triumph. In 1898 the *Wisconsin Engineer,* a student publication, printed in its January issue his article, "The Relation of Chemistry to Electrical Engineering";[65] in 1898 he received the advanced degree of E. E.., earned by his thesis on the capillary electrometer;[57] in 1898 he received a substantial increase in salary; and by the end of 1898 he learned that the College of Engineering was planning to grant a new degree—Bachelor of Science in Applied Electrochemistry—to students completing his new course. This would be instead of the B.S. (E.E.) previously granted for specializing in electrochemistry. Announcement of the new degree accompanied official recognition of Applied Electrochemistry as a full-fledged 4-year course. Virtually a department in itself, the course was still subject to Professor D. C.

Jackson as head of the Electrical Engineering Department but its direction would be largely entrusted to Burgess. Approval by the Regents was given on April 20, 1899.

In September 1899 the famous new course was definitely in operation. A handful of students began to receive instruction in the following subjects:

1. Primary and Secondary Batteries
2. Electrolysis and Electrochemistry
3. Applied Electrochemistry
4. Electricity as applied to the Treatment of Metal Surfaces (including subjects of corrosion, plating, cleaning, etc.)

Years later, a friend and colleague of Burgess made this comment:

> Though C. F. was still rated as an instructor in electrical engineering, he was now teaching four courses of study in electrochemistry and was practically directing the course—a remarkable record for a man only four years after graduation.

A new piece of equipment now appeared in the catalog, to be listed for a number of years to come. It was the "Burgess Electrometer Testing Set," that is to say, the instructor's own type of capillary electrometer. Not satisfied merely to describe this device in his thesis, he put it to work where he and his students could profit by using and studying it. He had a keen personal interest in testing the quality of insulation on electric wires and cables, and had not been satisfied with the performance of any commercial devices then on the market. The capillary electrometer seemed to be just what he needed for his own use in connection with his teaching of electrical testing and the testing of wires and cables. In response to a demand voiced in several places, Burgess was able to sell some of his electrometers. They were usually built for him by Allan G. Park of Madison, and were wanted mainly for measuring high resistances of the insulation used on electrical cables.

It is interesting to note that in spite of all the progress thus credited to Burgess, in learning, teaching, organizing and inventing, and in spite of the fact that he had been put in charge of an important new course of study, he was still classed as an instructor, not as a professor. This slowness of promotion seems not to have discouraged him. He knew that his work was being watched and appreciated, and presumably was content to leave the matter of promotion where it belonged, in the hands of his friend and chief, Dr. D. C. Jackson. As we have learned elsewhere, the reward of patient waiting did come early in 1900, when Burgess became Assistant Professor; his new responsibilities had brought him the dignity of a new title. He would be judged, however, not by his title but by his work.

Work there was a-plenty. In addition to his electrochemical teaching, Burgess gave a course in electrical installations; this included electrical testing and testing of wires and cables. He also continued to teach electric lighting and transmission of power. On July 1, 1900,

he engaged Carl Hambuechen to help him in his research work, and, for one semester, to instruct his students in the laboratory. In July 1901 Hambuechen, having completed his graduate work at the University, was assigned to outside work only, and the instructional work was taken over by Arba B. Marvin, who was also given the task of shaping Burgess's notes into a laboratory manual on electrochemistry for student use. This manual, turned out on the mimeograph, explained how to set up equipment, how to measure voltages, etc. It was illustrated by simple sketches. Forty-five years later, Mr. Marvin remarked that the manual was crude and primitive judged by modern standards. Then he added, "We had to feel our way along." So it is with pioneers; they blaze the trail and others ride the speedway. When Marvin left in 1902, his place was taken by James G. Zimmerman, listed in University records as a student assistant in applied electrochemistry. Zimmerman, an energetic and resourceful young man, was taking the four-year course, and graduated in 1904.

During all of this period, Burgess was busy cataloguing all technical articles of any interest to him, and some of the entries in his files show by their handwriting that he was assisted in this work by others, presumably by some of his students. Working at a time when research men had to create most of their own works of reference, he kept a very complete file of such data.

Burgess never missed an opportunity to add to his collection of equipment. With the right sort of outfit he could dramatize the "applied" character of his electrochemistry. In 1902 he wrote with pride to Professor W. E. Goldsborough, of Purdue:

> In spite of somewhat limited appropriations, we have gotten together the most complete electrochemical laboratory connected with any educational institution in this country, and one of the leading German electrochemists informs me that it is not equaled abroad.

In these words there was a trace of satisfaction with past accomplishment. But only a trace; for no sooner was one goal in sight than Burgess looked beyond it to another.

16.

Establishing the Chemical Engineering Course at Wisconsin

ONE of Burgess's good friends was John Butler Johnson, who was called to Wisconsin in 1899 to assume the newly-created office of Dean of the College of Mechanics and Engineering. Dean Johnson was a well-known civil engineer with rich experience both scholastic and practical. He had written some important works on surveying and building construction. After taking office he lived only three years; but they were years of notable service to the college, and to the department which had been entrusted to Professor Burgess. He sympathized with Burgess's theories of education, and promised to aid him in his efforts to establish a strong modern course in chemical engineering.

Burgess's line of thought and action sometimes puzzled his friends; it puzzled them right now. "Here," they said, "he has been working for years to get a four-year course going in electrochemistry; and before he's hardly given it a chance, he's off on a tangent, and this time it's chemical engineering. Why can't he do one thing at a time?" They simply didn't know their Charles F. Burgess. It was not his nature to do one thing at a time; even when he seemed to be concentrating on one thing, he was probably thinking of it as a stepping-stone to something else. After all, his new ambition was not to discard applied electrochemistry, but to make it part of a larger course serving all the needs of the chemical industries. He felt that before an applied electrochemistry course could be properly effective, it must be reinforced with adequate instruction in chemical engineering.

Dean Johnson had some good ideas about publicity. To help gain general support for the proposed new department, he enlisted the aid of Magnus Swenson '80, one of Wisconsin's most famous citizens, renowned as educator, inventor, chemical engineer and industrialist. Swenson responded generously, and gave several talks. The first of these, delivered in Madison early in 1900, was printed as Bulletin No. 39 of the University of Wisconsin,[258] and read throughout the State. Every statement made by Magnus Swenson was based on his own experience. He had seen chemical engineering work wonders—profitable wonders—in the production of such varied commodities as sugar, leather, tobacco, baking powder, soap, paper, cotton and glue. He prophesied similar results in virtually every other field of industry,

and called on the University of Wisconsin to aid the good work—and incidentally aid the State—by setting up a separate department of Chemical Engineering.

Burgess was delighted. He knew that this was the best possible type of propaganda, and he valued it highly as coming from a man who had started as a poor immigrant and then made spectacular progress as worker, teacher, inventor, scientist and business man. Burgess probably compared this progress with that made by his first employer, Sidney H. Short. Such careers appealed to his imagination, and served as models for his own career. Several years previously, Magnus Swenson, one of Wisconsin's best-known alumni, had appeared before the College of Engineering and given a special lecture on "Economical Evaporating Machinery." Discussing a field in which he was an acknowledged leader, he had spoken with authority. Burgess had been deeply impressed; and now the great man, speaking with the same authority, was helping him. Years later he declared that the department of Chemical Engineering was established largely through the efforts of Magnus Swenson, who had seen "the opportunities which were being presented and the demand which was being created for many in the chemical engineering field."

Help came also from Dean Edward A. Birge, Acting President of the University, in his baccalaureate address at Commencement on June 20, 1901. Opening with the words "Where there is no vision, the people perish," Dean Birge reminded his listeners that the University of Wisconsin had now completed its first half century, counting from the close of the first year of college teaching. He reviewed the progress made, and spoke of many forward steps to come. One of these had special meaning for Burgess:

> Immediately before us stands the need for technical training in chemical engineering. Great industries, representing thousands of millions of dollars in their annual product, depend upon the scientific and technical training of the chemical engineer; and as these manufactures develop, the University must be prepared to meet their need.

Aid was received from still another source. In 1898 a pioneer course in chemical engineering had been established at the University of Michigan, as one of the early achievements in the long teaching career of Professor Alfred Holmes White. Professor White, whose opinions were much respected, strongly supported Burgess's claim that the chemical engineering course belonged in the engineering school.

At this point in our story it is proper to ask a question about Professor Dugald C. Jackson. As head of the Electrical Engineering Department, he was still Burgess's superior officer. Just what was his attitude towards the proposed change? The answer is that Professor Jackson's attitude was altogether favorable; this in spite of the fact that a chemical engineering department would rob him of his applied electrochemistry students. Writing to Professor Jackson forty years later, Burgess said:

> Knowing the selfish interests which professors have and usually exhibit in trying to increase the number of students under their direction, one who knows the facts might wonder why you helped to start the Chemical Engineering Department . . . The answer is simply that you submerged your selfish interests for the good of the institution.

Even with the support of such men as these—and the expected approval of the legislature—the formation of a new department would take time. Work had to be carried on without interruption; changes had to be made gradually. Some of these changes are noted in the University catalog for 1901-02, where it appears that Burgess no longer teaches the course in electrical installations. However, his applied electrochemistry course now includes machinery and appliances, showing a trend towards chemical engineering.

Sooner or later, Burgess planned, he would have a real chemical engineering department located in a building of its own. He even began collecting things to put in the building as exhibits. He wrote to manufacturers of chemical and electrochemical products and equipment, asking for their literature, and, if possible, samples of their products, to be mounted and installed in the new building. A gratifying number of concerns responded favorably; they would be glad to have their products made familiar to students who might later be in a position to influence important purchases.

Burgess was interested in the catalogs and samples because they were means of promoting education. For the same reason he was interested in books, and in the wise choice of books for use in education. Early in 1903, in a letter to his future wife, Miss Ida May Jackson, he said, "The thing on my mind at present is the writing of the report to be presented at the Niagara Falls meeting of the S. P. E. E." This refers to his work as chairman of the book committee of the Society for the Promotion of Engineering Education. In 1904 that committee issued a catalog of scientific books suitable for public, industrial and school libraries; other editions followed.[70] Burgess served on the committee for some years. He was a good judge of textbooks; though he felt that few of them were perfect, he knew how to use them to the best possible advantage.

At least one textbook had no charm for Burgess. It was the book designed to help him study German. On March 6, 1903, he wrote to Professor C. F. Smith, Chairman of the Committee on Graduate Studies, stating that he had given up the idea of obtaining his Ph.D. degree "this year." The main reason for this decision seems to have been that he had not acquired a working knowledge of German. Later he recalled as a source of regret that his refusal to study German "proved to be an absolute barrier to the securing of an advanced degree in chemistry, regardless of the amount of time spent and results obtained in chemical studies." He had discussed this matter with his fiancee. Presumably to encourage him, she had taken up German, and had made some headway with it; whereupon he wrote to her:

Dr. Oliver P. Watts

> I was very much surprised at the progress which you have made in the short time in which you have been at it; but nevertheless my advice is to drop it. I do not advise this because I do not think you could help me, but it would take a long time to learn enough German to get through the stuff which I have to encounter, and I think that your time is more valuable to you for other purposes. Perhaps some day we may study it together.

They never did; and his continued "deficiency in German" cost him his Ph.D. However, he did not let the matter ruin his life. If he couldn't be a Doctor of Philosophy, he'd be a philosopher; maybe that was better; and on April 26, 1903, he penned another note to Miss Jackson:

> I have been writing an article for the Journal of Physical Chemistry today, and am planning various other literary ventures, or advertisements as they might more properly be called.

A very frank statement, proving that a real philosopher isn't afraid of the truth.

Burgess was still only an assistant professor. But he was doing important work, and was being assisted by a full professor—a Ph.D. at that—Louis Kahlenberg. Dr. Kahlenberg was giving his well-known course in physical chemistry, and a course in theoretical electrochemistry,[52] to the applied electrochemistry students. Burgess and Kahlenberg differed on teaching methods. Kahlenberg was insistent that chemical engineering should be taught as a part of the chemistry course, and Burgess was just as insistent that it should be taken care of in the engineering course; and when it appeared sure that a chemical engineering department would be established, with Burgess at its head, Kahlenberg was frankly antagonistic. The situation was spoiling a worthwhile friendship.

Thursday, June 18, 1903—just a week before Burgess's wedding—was Commencement Day. The ceremonies in Armory Hall were impressive: Prayer, orations, music; then the conferring of degrees. Burgess's big moment came when three young men stepped forward to receive the new degree of Bachelor of Science in Applied Electrochemistry. They were the famous first three graduates from his four-year course. Here let their names be registered again:

Minot James Hill, of Almond, Wisconsin
William Roy Mott, of Decorah, Iowa
Clarence Irving Zimmerman, of Milwaukee, Wisconsin

The three rejoiced in the possession of their new degree; but a year was to pass before promotion came to Burgess. After Commencement in 1904 he was raised from assistant to associate professor, still of electrical engineering. J. G. Zimmerman, his student assistant, having graduated with B.S. (Ap.E.C.), left the University, and George M. Norman came. Norman, enterprising and full of ideas, got along with Burgess very well. They discussed plans for commercial work and for establishing a manufacturing concern; but Norman found opportunities elsewhere, and taught at Wisconsin only till June 1905.

In his letters of this period Burgess has a great deal to say about

the electric furnace. In an undated note of about July 1904 he writes:

> The equipment of the laboratory of applied electrochemistry and electrometallurgy has been slowly built up during the past twelve years. The most important addition recently made is the apparatus for electric furnace operations.
>
> For work with high temperatures, electrically generated, the facilities offered cannot, probably, be excelled in any laboratory in the country. 300 kilowatts of electrical energy can be turned into the furnace, and temperatures high enough to melt and vaporize every known substance are thereby attained.
>
> Various types of electrical furnaces are constructed and operated by students.

Keenly interested in electric furnace work was Oliver P. Watts, a graduate student in Burgess's department, who was soon to receive his Ph.D. and to do important work in teaching; also in electrolytic iron research under the Carnegie Grant, as recounted in Chapter 13.

No matter how important the task of the moment, Burgess never forgot his main objective, the Chemical Engineering course, soon to be realized. He prepared newspaper articles which described the new course, and referred also to the establishment of a gas engineering course. Typical of his "advertising" campaign was the effective use he made of reprints of his long article entitled "Electrochemistry at the University of Wisconsin," which appeared in *Electrochemical Industry* in 1904.[52] He obtained several thousand of these reprints and sent them to high schools, and used them in other ways whenever he thought there was a possibility of obtaining students for the new chemical engineering course. In addition to writing articles and distributing reprints, he conducted an active correspondence with business and industrial leaders, especially those known for their interest in education. In December 1904 he wrote to his friend Herbert H. Dow, later president of the Dow Chemical Company, telling him about the new course, and adding:

> I want to talk this matter over with you more fully, so as to profit by your practical ideas in this direction. If I have your permission I will submit to you later the proposed outline of studies, for criticism which will be especially valuable, as you know what qualities the chemical engineer should possess, and also the means for cultivating such qualities.

Mr. Dow, who was seven years older than Burgess, did take an interest, and did give the benefit of his counsel. They had first met as charter members of the American Electrochemical Society, and they had much in common; as Burgess said later, "he took an interest in what I was trying to do, and I was fascinated by his unrolling to me the things which he wished to accomplish." Contacts of this type were valuable to all concerned. The two men in this case each contributed to the other's knowledge and profit, and each advanced the cause of education. Burgess consulted other leading men in 1904 and 1905, and was glad to get their views on the projected course and how it should be administered. At the same time he was busy preparing to buy equipment. He must have used good judgment in deciding what to buy, for much of the equip-

ment he acquired in 1905 was still giving good service to the University in 1948.

In 1905 Burgess served as class adviser of graduate students, and secretary of the Graduate Committee. While this position brought honor, it brought a good deal of added work. It was accepted temporarily as a favor to Professor George C. Comstock, Wisconsin's noted astronomer, during his leave of absence in Europe. When Professor Comstock returned he assumed the work, becoming Director and Dean of the Graduate School.

Burgess's talents were in demand not only in Madison, but elsewhere. Early in 1905 he was offered an attractive, well-paid post at the Case School of Applied Science, Cleveland, Ohio. On April 24, after an exchange of several letters, he wrote to the president of the school, Dr. Charles S. Howe, as follows:

> The position which you had the kindness to offer me is certainly an attractive one, and our authorities asked me to name conditions which would make reappointment here more attractive. These conditions did not seem beyond reason to them, and as a result I am to be given charge of the new department of chemical engineering in our college. The increase of salary and opportunity for development thus afforded in addition to certain business reasons, make it desirable for me to remain in Madison.

From this letter it seems that the Case School offer resulted in boosting Burgess's income, and perhaps also hurried up his promotion. At any rate, it was followed by several months of hard work, during which, as he wrote to a friend, he was busy preparing for the chemical engineering course, also "remodeling our building for chemical engineering."

"Remodeling" sounds tame. But this was remodeling by Charles F. Burgess; and thereby hangs a tale. What Burgess called "our" building was the old Chemistry Building. Months before the Chemistry Department moved into its new building, there was a scramble for the old one; applicants included the English department, the Medical school, and others. "Others" included Burgess, whose new Chemical Engineering department stood a poor chance because, as he admitted later, he had "only six or eight students." By talking very fast, Burgess got someone to issue an order allocating to his group at least part of the building; and in his mind it was to be the most important part. Then he unobtrusively put through an order for the casting in bronze of some large letters, assorted as follows:

E	4
I and N	3 each
C and G	2 each
A, H, L, M, R	1 each

The total was nineteen letters; the order was "rush." Then one dark night, over a certain main entrance, a scaffolding went up. Mysterious sounds were heard—heaving and huffing and hammering; equally mysterious lights were seen. Came the dawn. And there, high above the portal of what *had been* the old Chemistry Building, was a new name,

in letters of imperishable bronze. The nineteen characters, now rearranged, spelled CHEMICAL ENGINEERING.

Almost half a century later, the incident was recalled by one of Burgess's students, his friend and associate Professor O. L. Kowalke '06. Interviewed by the author, Professor Kowalke said:

> It showed how quickly Burgess could follow up an advantage. His putting the sign there was fortunate. Very shortly after that, the Medical crowd moved in; those fellows were growing pretty fast; they tried to get us out. But Burgess—he always pointed to the letters, anchored to the front of the building. They are still there.

As a matter of fact, Burgess and his little band of Chemical Engineers, having staked their claim with the famous sign, did not move into their new home for several months, and when they did they had to share it. But wherever they were, Burgess kept them busy; and he was busier than ever, organizing the full four-year course in Chemical Engineering, scheduled to start in the Fall, offering its graduates the degree of Bachelor of Science in Chemical Engineering.

Burgess attached a great deal of importance to the significance of fives and tens in periods of years. In one of his notebooks he wrote these words of comment: "In 1895 when I began teaching I aimed at becoming head of department—it took me ten years to get there." July 1, 1905, he got there. On that date, at long last, he became a full professor. His *title* was Professor of Applied Electrochemistry; his *department*, though officially given a longer and more general name, began to be known simply as *Chemical Engineering.*

17.

Professorship at Wisconsin 1905-1909

ANY plan of incidental music for the Burgess life-story would call for frequent renderings of "Where do we go from here?" In this career there seem to be no destinations; just stopping-places on an endless route. We have just brought our hero to a comfortable climax, with a worth-while promotion, a raise in salary, a realized ambition; all as of July 1, 1905. But less than six weeks later, when Burgess thanked a friend for congratulations, he added:

> My new departure may not prove to be an unmitigated pleasure, especially since it ties me up more firmly to University work, and will make it more difficult for me to realize my ambition of getting into technical lines.

It was "more difficult" for him to get into technical lines; but it was not impossible. While serving the University effectively, and in some ways brilliantly, he managed to keep in constant touch with "technical lines." Important contacts with other educators, and with leaders in business and industry, were a natural outgrowth of his university activities. People who read his papers often tried to duplicate or supplement his researches; and when he used devices of his own design, unobtainable in the market, they would apply to him for equipment. He usually obliged by building the required instruments, apparently at cost. Much of this work was done in the University shops by University technicians. Everybody profited, in information and experience.

In September 1905, as Burgess launched the new course in Chemical Engineering, he was assisted by Dr. O. P. Watts, who worked largely on electrolytic iron under the Carnegie Institution grant, and by Instructor O. W. Brown, who soon returned to Indiana University and became one of the nation's leading academic electrochemists. Toward the end of the first semester they were joined by Assistant Professor J. C. Dickerman.

For some time Burgess had been planning to offer a complete course in gas engineering, as part of the Chemical Engineering course. The gas industry was in urgent need of trained men, and he did what he could to meet this need by enlarging his curriculum.[76] It was to assist in the teaching of gas engineering that he engaged Assistant Professor Dickerman. Burgess had become interested in this subject largely through the

influence of a fraternity brother, William A. Baehr '94, who in 1891 had helped initiate him into Beta Theta Pi. "Billy" Baehr, a lifelong friend, born in the same year and city as Burgess, was to become prominent in public utility circles.

Late in 1905 a letter came from William J. Hammer, in which the famed engineer asked for advice. He wanted to give his unique collection of electric lamps to a public institution, and was uncertain whether it should go to the Smithsonian in Washington or the Engineering Societies Building in New York. Burgess could well be proud that he had been consulted, for he was one of a select group advising in this matter, including Carl Hering, Elihu Thomson, Arthur Kennelly, Frank Sprague, and other outstanding men in science and industry. The collection of lamps eventually went to the museum of The Edison Institute, at Dearborn, Michigan.

University activities at this time were manifold. In his May 1906 report to Professor F. E. Turneaure, Dean of the College of Engineering, Burgess pointed out that he was busy with the work for the Carnegie Institution, and that other lines of investigation included:

> The concentration, purification and reduction of zinc ores, the corrosion of iron and other metals, the production of calcium, antimony, tungsten, chromium and various other materials; the recovery of tin scrap.
>
> Investigation of the properties of refractory materials has led to the discovery of methods for making crucibles, tubes and other articles of magnesia, these articles being far superior to any that can be obtained on the market.
>
> In an investigation of the production of silicoborides, a number of combinations heretofore unknown have been produced. Many other minor investigations have been carried on, but perhaps need not be specified.

The closing paragraph of the report illustrates Burgess's interest in prompt and adequate publicity for worthwhile new material contained in papers written at the University. It was a cause for which he never ceased to fight. On this occasion he said:

> Another reform of which I am an advocate is the more prompt publication of engineering bulletins. Last July Dr. Watts offered the manuscript for a bulletin covering the subject matter of his doctor's thesis. This has not as yet been published and apparently will not be for some time to come.
>
> This great delay is not only an injustice to Dr. Watts, but it reduces the value of the publication by making it old matter. In fact, some of the results which were obtained by Dr. Watts have appeared in publications by others during the past few months.
>
> I consider it absolutely fatal to the success of our engineering bulletins if they can not be published very promptly after the manuscript is submitted.

At Commencement in 1906, the degree of B. S. in Applied Electrochemistry was conferred on Beverly B. Burling, Arden R. Johnson and Otto L. Kowalke. They were the last to receive this degree, which was replaced by B. S. in Chemical Engineering. Kowalke stayed at Wisconsin; in 1947 he celebrated his thirtieth year as Professor of Chemical

Engineering, his forty-first year as a teacher; and in June 1948 he took an honored place on the retired list.

Not all of Burgess's friends were to stay at Wisconsin as long as Otto Kowalke. In 1906 came the news that Professor Dugald C. Jackson would soon leave, to head a department at the Massachusetts Institute of Technology. The editor of the *Electrical Review,* knowing that the departure of Professor Jackson would mean a deep personal loss to Burgess, wrote asking for details. Burgess replied, October 30, 1906:

> You inquire whether this has thrown any additional responsibilities upon my shoulders, but fortunately it has not, since our courses in Applied Electrochemistry were transferred to the department of Chemical Engineering, of which department I now have direction.
>
> Our work in Applied Electrochemistry and Electro-metallurgy is progressing satisfactorily, and, while I do not have a large number of students, various parts of the country are represented. Professor Oliver W. Brown, who was instructor in my department last year, has resigned to accept a professorship at the University of Indiana, and Dr. Oliver P. Watts has succeeded him.

On Saturday night, January 26, 1907, the friends of Professor D. C. Jackson gave him a farewell dinner in the electrical laboratories at the University, and Burgess worked hard to make the affair a success, which is was. Prominent in the program was Burgess's humorous biography of Professor Jackson, illustrated by lantern slides showing the honored guest at all stages of his life, including early infancy. Sentiments of the meeting were expressed in a song to the tune of "Mister Dooley," one verse of which ran as follows:

> There is a man who's been with us
> These fifteen years or more,
> And now he's going to pass us up,
> And we are mighty sore.
> But there's one fact that gives us joy,
> He's not an "also ran,"
> Old Boston had to send out here
> To get an A-1 man.
> O Mister Jackson, O Mister Jackson,
> When YOU get there the Hub is going to spin,
> O Mister Jackson, O Mister Jackson,
> When YOU start in we know you'll always win.

Professor Murray C. Beebe took charge of the Electrical Engineering Department in 1907, and conducted it till he left the University eleven years later.

Writing to George M. Norman, in October 1906, Burgess says:

> We are now occupying the old chemistry building, which has been remodeled, and are also retaining some of our laboratory space.
>
> We have about twenty freshmen, sixteen sophomores, and about a dozen of the two upper classes.

About four dozen students in all. Assisting Professor Burgess in

teaching them were Dr. O. P. Watts, Assistant Professor J. C. Dickerman, and assistant O. L. Kowalke; they helped with the courses in applied electrochemistry and electrometallurgy; Dickerman and Kowalke were instructors for the courses in chemical technology, and Dickerman continued teaching gas and fuel analysis. It was now possible to obtain the advanced degree of Chemical Engineer, and the distinction of earning the first Ch.E. went to Simon G. Engle '07, sometime of Tulsa, Oklahoma. In 1906 Engle had been joint author with Burgess of a paper "On the Corrosion of Iron by Acids."[5]

In May 1907, five years after joining the American Electrochemical Society as a charter member, Burgess became president of that organization, a position he filled with honor and hard work.

By September 1907 the chemical engineering course included studies in illumination and photometry, taught by Instructor William E. Wickenden, later well known as head of the Case School of Technology, Cleveland, O. Mr. Wickenden was "loaned" for this purpose by the Electrical Engineering department.

In December 1908, Burgess received a letter from General Manager T. J. Neacy, of the Filer & Stowell Co., Milwaukee, makers of sawmill machinery and engines. Mr. Neacy expressed his thanks for some aid that had been given him in finding the right sort of technical men. His letter continued:

> I might add that in practically every line of trade, the owners, off and on, find it handy to have the University to call on for information or assistance, as in this instance.
>
> It was my pleasure and privilege at the last legislature, to appear before a committee to urge an additional appropriation for the University, and as I will have to go to Madison during the next legislative session, if it is made clear to me that the University needs funds to extend its usefulness, I can be counted on to do my best to have the legislature supply them.

Burgess expressed gratification, and added:

> It is the policy of the administration of this University, in which we are all attempting to cooperate, that it be as useful as possible to the state; and if you will call on us for such assistance as we can give from time to time, we shall consider it a duty, as well as a pleasure, to do whatever we can.

Although, from the summer of 1905 on, Burgess had been head of the Chemical Engineering department, the title he received at the same time did not proclaim the fact. "Professor of Applied Electrochemistry" described only part of his duties. As early as April 1907, in a letter from the University office, he had been addressed as "Professor of Chemical Engineering": this was evidently a slip, but it did show a natural tendency to make the title fit the function. In a letter he wrote April 7, 1909, submitting his budget for the coming year, he said:

> As for myself, my present title is "Professor of Applied Electrochemistry." If it is desired that I shall continue in the work

> of supervision of the Department of Chemical Engineering, which includes work in Applied Electrochemistry, I would request that my title be changed to read "Professor of Chemical Engineering."

This reasonable request was promptly granted.

The harder Burgess worked, the better he became known. The better he became known, the more work came his way. 1909 was a year. of expanding activities. The Professor of Chemical Engineering was receiving more consulting work than ever. In addition to his important work on batteries, his projects included tests of the sherardizing process, and consulting service relating to electrolytic production of chlorine, caustic and hypochlorite. There was also consulting work in the field of electrolysis. As one of his friends put it, "The years of hard work were beginning to bear fruit."

Recognition of Burgess's high standing in his profession came from many sources. Dr. Maximilian Toch, noted authority on paints and enamels, spoke appreciatively of his work and of his teaching ability. After a correspondence regarding the use of paint or other corrosion-resisting material on the surface of iron pipe imbedded in concrete, Dr. Toch wrote, on April 30, 1909, that the University was to be congratulated on having Burgess on its faculty. He then stated:

> I know of no institution where these engineering problems are so thoroughly gone into, and I am only sorry that you are not in some university near New York where more students could obtain the benefit of your excellent methods.

From such a source this was indeed a worth-while compliment.

Instruction in Gas Engineering, started by Burgess in 1905, had assumed added importance in 1907 and 1908, when he began to serve the Wisconsin Railroad Commission as an expert on light and heat. As early as May 1907, he wrote to Paul Doty, of the St. Paul Gas Light Co., "I am cooperating with the University Library authorities in an attempt to get together one of the most complete libraries relating to the gas industry in the country." In 1909 Burgess became a member of the Calorimetry Committee of the American Gas Institute, and early in the same year he was giving a new course in gas manufacture, using as one of his textbooks the *Gas and Fuel Analysis* of Professor Samuel W. Parr of the University of Illinois, with whom he was later to have business relations. In a letter to Dean Turneaure he said that the new course "will probably be taken by a larger number of students next year."

The "larger number of students" would naturally take up more room. It was now four years since the nocturnal adventure in which Burgess had, as it were, signed and sealed his claim to the "Chemical Engineering" building. But he still did not have undisputed occupancy. In his letter of April 7, 1909, to Dean Turneaure, he explained:

> It is hardly necessary for me to point out the disadvantages under which we are working, due to limited laboratory space. A great improvement over present conditions could be effected

> if our laboratories were all in one building, instead of in two as at the present time.
>
> Our space in the Chemical Engineering Building is very completely occupied and efficiently used, and while we plan to accommodate very much more work next year, and a larger number of students, we do not know how we are going to figure it out unless we can secure additional space. I trust that we may look forward at no greatly distant date to occupying some of the room on the second floor of this building.

Considered as a housing shortage, the situation described is a sad one. Burgess was manifestly not sad; he looked on it as a good omen, a sign of growth. And if more students came, he'd find a way to take care of them.

18.

Establishment and Incorporation of Laboratories 1910—Resignation from University 1913

EARLY in July 1909 a letter was addressed to Professor Burgess by Fusanobu Isobe. Isobe, known to his friends as Paul, had traveled from Japan to America without a cent to spare, and worked his way through the common schools and through Indiana University, where he had just taken his B.A. Now, at the age of twenty-five, he wanted to take post-graduate work in electrochemistry, and for this purpose he had been advised by Professor O. W. Brown, of Indiana, to go to Professor Burgess. Burgess promptly wrote to Professor Brown:

> I have just received a letter from Mr. Isobe . . . He referred me to you as to his qualifications, and I should be glad to have any comments which you may make about him, about his knowledge of chemistry, his ability to do accurate work, and his adaptability to investigation work.
>
> His coming will be contingent upon his securing work which will pay his living expenses. I cannot offer such assurance, although there is a probability of my being able to give him some work such as analytical or research work which would pay at least a portion of his expense.

After a further interchange of letters, Isobe appeared in Madison, where he studied electrochemistry with the class of 1910. He had a good mathematical and chemical background, and explained that his main purpose in coming to Wisconsin was to study electrolytic bleach under Professor Burgess, "the world's greatest authority on this subject." Burgess smilingly disclaimed the compliment, but took special pains to help the eager young chemist along. As a matter of fact, Burgess gave him work in his department at the University, and a room in his house on Adams Street, for which the student paid with cheerful service. Isobe was proud to be a member of his professor's household, and Burgess in turn was pleased when, in 1910, his protégé earned the degree of M.S. Isobe's thesis work related to the electrolytic production of bleach, which had been the main subject of his studies. Some time in the following year he left Madison, having made, in the words of Burgess, "an exceptionally good impression."

Six of the students received their B.S. (Ch.E.) in 1910. Two of them, Walter B. Schulte and Oliver W. Storey, were to be close associates of Burgess for many years.

Many of Burgess's students visited him in his home. On such occasions much of the conversation was about their college work and its relation to their life work. Burgess had no objection to talking "shop"; it was the kind of talk that never bored him, and he had the knack of making it interesting. And if at times the atmosphere became a bit too heavy with technicalities, the professor's wife could be counted on to do something to lighten it. As she understood her husband, so she understood his students, and her gracious influence was felt by them all. Through many years that followed, when they wrote to Professor Burgess, they asked to be remembered to his wife.

Early in 1910, Mrs. Burgess was away from Madison. She had taken Betty and Jack to the warmer climate of Biloxi, Mississippi, where they were to see their Uncle Charles Tenney Jackson. Little Jack was then a sufferer from infantile paralysis, and his recovery may be credited at least in part to the influence of southern sunshine; but it is interesting to note that he received positive treatment not unlike that discovered at about the same time in Australia by Sister Elizabeth Kenny, and by her developed successfully till it earned worldwide fame. Perhaps we ought not to forget a third likely factor in what then seemed a miraculous cure; this factor was the physical toughness, in polite language called stamina, inherited from two lines of sturdy ancestors. This same element of strength in the family constitution had lately aided Burgess's brother Kenneth in overcoming a severe illness diagnosed as Hodgkin's Disease, usually classed as incurable. The physicians attending Kenneth followed a course suggested by two Wisconsin men, Dr. Charles R. Bardeen, Dean of the Medical School, and Dr. Charles H. Bunting '96, professor of pathology and bacteriology. Charles F. Burgess was grateful to the medics of his Alma Mater, and in a letter to Dr. Bardeen he said:

> I am convinced that this service was a means of saving this young man's life and of effecting a complete cure. . . . I wish to express again my appreciation of the excellent scientific, technical and educational work which is being done by your department, at the same time expressing my deep personal gratitude to you and your associates.

Kenneth had been in the care of doctors all of one winter; the necessary funds came from Charles and Ida, who quietly sold a place overlooking Lake Wingra which they had bought for themselves and on which they had set their hearts. It was a real sacrifice, especially for Ida; but it was gladly made, and richly rewarded.

While Mrs. Burgess was down in Mississippi, her husband wrote to her almost daily. In his letter of March 23, 1910 he said:

> Gee, but I have been busy—something doing every minute —and frequently things "happen".
>
> I have gotten so I actually enjoy Kahlenberg's solicitation of my students to abandon my department for his—enjoy the knockings of my various alleged friends.

Burgess's brother George once said of him, "He never sought a fight, and never ducked one." As to the rivalry with Kahlenberg, which was "enjoyed," there was a painful side to it. Kahlenberg's physical chemistry course was a required subject for Burgess's chemical engineering students, and they had a difficult time with Kahlenberg because he seemed almost antagonistic toward engineers; so, as one of them recalls, "We engineers were an unhappy lot in Kahlenberg's course."

But what about those "knockings" that were mentioned in Burgess's note? He professed to enjoy them, but he couldn't resist mentioning them. Just what were they? Possibly we may get an inkling of what was going on if we turn to a report which Burgess prepared for Dean Turneaure in September 1910. It states in part:

> O. P. Watts has been employed in the electric furnace laboratories of the General Electric Company of Schenectady, N.Y. O. L. Kowalke has been employed by the Railroad Commission of Wisconsin on the inspection of gas plants thoughout the State.

Nothing exciting there. But what about this other paragraph?

> During the summer vacation just ended, several members of the faculty have been engaged upon professional work closely allied with their instructional work. C. F. Burgess and James Aston have been aiding in the organization of a laboratory for industrial chemical research, and have been carrying on work for various industries, including the calcium carbide, electrolytic oxygen and hydrogen, carbon products, dry cells, etc.

Burgess *et al* seemed to be engaging in outside work on a somewhat larger scale than customary. Can it be that the objectors had been gossiping about this enterprise, even before it was born? Or had they just been grumbling on general principles, because of Burgess's known success in private work? In any case, they were probably interested in the following item, presumably written by Burgess, in the March 1911 issue of the *Wisconsin Engineer*:

> Incorporation papers were issued on December 1 to the Northern Chemical Engineering Laboratories, located at 625 Williamson Street, Madison. These laboratories have been in operation since June, 1910, and have for their purpose the carrying on of research, experimental and development work along Chemical Engineering lines. The incorporators are Wisconsin Chemical Engineers, the officers being C. F. Burgess, James Aston, O. E. Ruhoff, and Carl Hambuechen.

By April, 1911, Burgess thought it useful to make another report to Dean Turneaure. Part of it is given in his own words:

> One of the main purposes in writing this statement to you is to deal with my own relations with the department. Not more than half and possibly somewhat less than half of my working time is devoted directly to University matters. I am engaged in consulting and professional work, and am President of an industrial research laboratory located in Madison and known as the Northern Chemical Engineering Laboratories. My principal contact with the students comes in a lecture which is given twice a week to a class numbering 26 and comprising mostly juniors,

Original home (1910) of C. F. Burgess Laboratories at 625 Williamson Street, Madison, Wisconsin

> and a seminar which meets at my home on Tuesday evenings from 7:30 to 10. I have supervisory relations to the other work given in the department and of a number of theses.
>
> My work done outside of the University is in the line of chemical engineering, and such as to better me to give instruction and to maintain the relationship between college and industries which is generally conceded to be desirable.
>
> Another factor which makes it absolutely essential for me to undertake this outside work is the matter of remuneration, the University salary being considerably under my living expenses. It is hardly necessary to point out that the rate of remuneration which I am receiving from the University for the time which is put in is materially lower than that for the time devoted to outside work.

At this point of his statement, Burgess explains in some detail how the work of the University is actually aided by the outside work. The statement continues:

> It is work of this nature which the Northern Chemical Engineering Laboratories is carrying on. This organization was started less than a year ago, and at the present time its resources amount to about ten thousand dollars a year from industries which have made appropriation for industrial research, and considerably larger amounts are in prospect.

Another section of the same report explains why the Chemical Engineering department seems to be growing rather slowly, and stresses the fact that the work done by the department cannot be measured by simply counting the students registered for Chemical Engineering:

> According to the last directory, the registration in Chemical Engineering is: Seniors 5; Juniors 9; Sophomores 16. In addition there are seven graduate students taking their major work in this department. . . . While this may appear to be a small number when considering that the course has been in operation for about five years, there are various factors to which attention may be called. It appears that of the various departments in the Engineering College, this department is giving the most instruction *to students not registered in the course.* A considerable number of students taking work in the college of Letters and Science are taking work here, as are also most of the mechanical engineering and electrical engineering students.
>
> In the growth of this department we have been hampered by various circumstances. The chemical engineering department when first started had as its basis the applied electrochemistry department, the majority of students who took this work being registered in electrical engineering. By changes in the system of elections it became impossible for the electrical men to continue in this work, and the electrochemical students now include very few electrical engineers. Then came the establishment of the Mining department, which diverted a number of students registered in Chemical Engineering, and shortly after the Course in Chemistry was established, one branch of which is for Industrial Chemistry; and this again diverted increased numbers of students from Chemical Engineering.

Laboratories' Building at 1015 East Washington Avenue, Madison, Wisconsin, erected 1916-17

Then follows a characteristic touch of Burgess—a silver lining to relieve the cloud:

> Notwithstanding these factors, the number of students to whom instruction is being given in this department is rapidly increasing.

As a matter of fact, Burgess was doing a first-class job at Wisconsin. His superiors knew it, he knew it, the heads of other institutions knew it. It was these last-named who often tried to make him quit Wisconsin. In March 1911 he was offered a very important opportunity in Pittsburgh. It was an opportunity to organize and then take charge of the projected Mellon Institute. The offer came in a letter from the noted chemist Robert Kennedy Duncan, Director of Research and Professor of Industrial Chemistry at the University of Pittsburgh. The message was confidential then, for obvious reasons, but now no harm can come from quoting it. It was dated Sunday March 5, 1911, and said in part:

> I have thought of about everybody, and it seems to me that you ought to be the man to take over this work. Candidly, I believe that probably the opportunity for you would be unique.
>
> The position here carries with it a salary of five thousand dollars a year together with the services of a private secretary. This, however, is the least part of it. The simple fact is that Pittsburgh is a Klondike of opportunity, and I should think that you ought to be able, outside of the conduct of this work, to take consultative retainers that might triple, or, for all I know, quadruple your income. In the conduct of your work you could not possibly have a better opportunity for increasing your already splendid reputation.
>
> The work has not yet begun. We expect to have an efficient temporary structure ready in six weeks, and it is reported that a permanent building will be ready in about a year. I enclose a list of those Fellowships accepted, practically arranged for, and on the tapis; but you must understand that as soon as things are started the demands may be expected to be far more than can be accepted.
>
> How would you like to meet me in Chicago to talk it over? With cordial regards to Mrs. Burgess,
>
> Sincerely yours,
> Robert K. Duncan.

Appended to this letter was a list of fellowships involving research projects that must have tugged hard at Burgess's heart-strings. There they were—most of them definite or arranged for, a few of them "on the tapis," all of them alluring. And money! As much as was necessary. The projected researches covered such items as bread, smoke abatement, glass, glue, soap, silver alloys, enamel for cooking utensils. Others that must have appealed to Burgess were fruit waste, leather, vanadium steel, rubber, wood pulp, iridium from certain ores, petroleum, etc.

After a few days, Burgess sat down and wrote a long, cordial letter of refusal, from which we also quote:

Vroman Mason

Carl Hambuechen

James Aston

Early Associates of Burgess in Laboratories

> In perfect propriety, the factor controlling my decision should be modesty and doubt of my ability to carry on the great work which you have begun in Pittsburgh. But the fact is, I do not see how I could abandon certain projects I have undertaken.
>
> Feeling that I am in the way of realizing my ambition to make the Chemical Engineering Department one of the most important at Wisconsin, I am under obligations to some very able assistants who are loyally helping me in this purpose.
>
> Also, about eight months ago I organized a laboratory to carry on industrial research and development work, designated as the Northern Chemical Engineering Laboratories. Associated with me are three young men of scientific attainments who left good positions to go into this work, and it would be an injustice to them to withdraw my support in achieving the results toward which we are looking.

In reply to this letter came another, suggesting that the desire to get Burgess to Pittsburgh was so great that arrangements could be made to open good opportunities to his associates also! Then he could leave Wisconsin and his new project with a clear conscience. And, if Burgess could not be tempted even thus, would he please try to recommend someone else? It is not known whether Burgess suggested any other men; but other men were found, and the Mellon Institute still serves the purpose for which it was established—"To provide qualified workers with facilities for investigating thoroughly problems of importance in pure and applied science."

In the Fall of 1911, Burgess had the pleasure of seeing his younger brother, Kenneth F. Burgess, listed in the University records as an Instructor in Commercial Law. Kenneth, who had been active and popular at Wisconsin (in the 1909 *Badger* there are five portraits of him), received his LL.B. in 1912, and in the same year started practicing law. From then on his career was one of steady progress, and Charles, his senior by fourteen years, spoke of him with pride that was almost paternal.

Filial pride also was stirred by something that happened at about this time, when Burgess's mother was invited to come with his wife to a tea arranged for University wives. Burgess said afterwards, "Well, Mother, how did you enjoy meeting all those people?" "I liked it," she replied; and added "I made a speech." "Golly!" exclaimed Burgess—"What did you talk about?" Then Ida explained that the chairman of the tea had said, "We have an honored guest here today, Mrs. Frederick Burgess, of Oshkosh. We would like to have her say a few words, and we have asked her to speak on a subject on which she is an unquestioned authority." The subject had been stated in the form of a question: "How do you raise such fine sons?" The visitor, rising nobly to the occasion, had talked for half an hour on how to raise children. The university wives had listened spellbound. Anna Heckman Burgess had given one of the best talks of the season.

In 1911 Charles A. Mann '09 was added to the teaching staff as an instructor in chemical engineering, a position which he held

until 1916 when he went to Iowa State College as Associate Professor of chemical engineering, soon to take charge of the department.

One of Burgess's several controversies with the faculty occurred at this period, when he asked that they remove from the chemical engineering course what he called "the mathematics barrier." He wished also to decrease the work which had to be done by men taking other engineering studies, such as machine design and certain phases of mechanics. The faculty was unwilling to make any concessions, and, quoting a contemporary:

> There were some rather bitter words about it. C. F. did not foresee the day when higher mathematics would be used extensively in problems of chemical engineering design.

On June 29, 1912, Burgess submitted to Dean Turneaure an eight-page report on the work carried on by his corporation, the Northern Chemical Engineering Laboratories, now over two years old. This was in reply to a query raised by one of the members of the Board of Regents which had been brought to his attention. After outlining the projects so far undertaken by what had been termed his "commercial laboratory"—many of which projects, as explained earlier, would expedite rather than hinder the work of the University—Burgess continued:

> It is of course evident that our laboratories were not organized from purely philanthropical motives, and I do not wish to convey such impression, as the continuation of them depends on getting sufficient work to make them profitable. They have been profitable thus far, financially as well as in other ways, and I expect them to be more profitable in the future.
>
> I should be glad to go into any other points which may be of interest to either you or President Van Hise or other officials of the University, and shall be greatly pleased if there is sufficient interest to cause you to look further into the details of the Northern Chemical Engineering Laboratories' work.
>
> Sincerely yours,
> C. F. Burgess.

On July 2, Dean Turneaure replied:

> I saw President Van Hise today and he thought that your commercial laboratory was the point which caused the query of the member of the board of regents, which you know about. I gave him a copy of your letter to me, which is very full and explicit, and also explained to him what our policy has been relative to commercial problems in our laboratories. He fully agreed with me on the general policy, and will, I am sure, fully approve of your method of handling things.

Nothing further seems to have been heard from the querying Regent. Presumably the query had been answered to his satisfaction.

In the Fall of 1912, Oliver W. Storey became an Instructor in chemical engineering, and so continued till 1914.

In November 1912 Burgess wrote another letter to Dean Tur-

neaure; this time there was no explaining to do about "outside" work. Professor Turneaure was visiting Germany, and Burgess's letter of November 8 went to an address in Munich. One item of news was to the effect that "the country has just been saved by the election of a college professor as president." Perhaps in the spirit of "We schoolmen must stand together," Burgess had voted for Wilson. In later years he said, "I voted for Wilson, and for Women."

But no matter who voted for whom, schoolmen persisted in voting for Burgess. On June 27, 1913, the president of the University of Missouri asked him to consider the position of dean of that institution's school of engineering. Professor Burgess promptly replied that he had recently decided to give up educational work, having resigned from the University of Wisconsin to carry on industrial development work.

The separation had come at last. It started—well, if you look back you'll see symptoms of it in Chapter One, when Charlie Burgess was only eighteen. In one form or other it had been starting ever since. It began to become official on the first day of February 1913, when Burgess added another to the long list of letters he had addressed to Dean Turneaure:

> Dean F. E. Turneaure, February 1, 1913
> Engineering Building.
> Dear Mr. Turneaure:
>
> This year will complete the eighteenth year of my continuous service to the Engineering College, and after giving the matter very careful consideration I have arrived at the conclusion that it is to my best interests and in fact possibly to the best interests of the college that I make this year my last one.
>
> As you know, it has been my enthusiasm for the possibilities in Chemical Engineering that has kept me here for several years, and I feel gratified that the progress of the Chemical Engineering Department is now very satisfactory and indicating that it is going to be one of the most important of the engineering departments. I hope that every opportunity will be given to it to prosper in the future.
>
> Very truly yours,
> CFB:BW C. F. Burgess

Almost seven weeks went by without any official notice being taken of the letter just quoted. On March 19th, when Burgess wrote his customary long letter outlining the requirements of the Chemical Engineering Department for the coming year, he was careful to use the word "resignation":

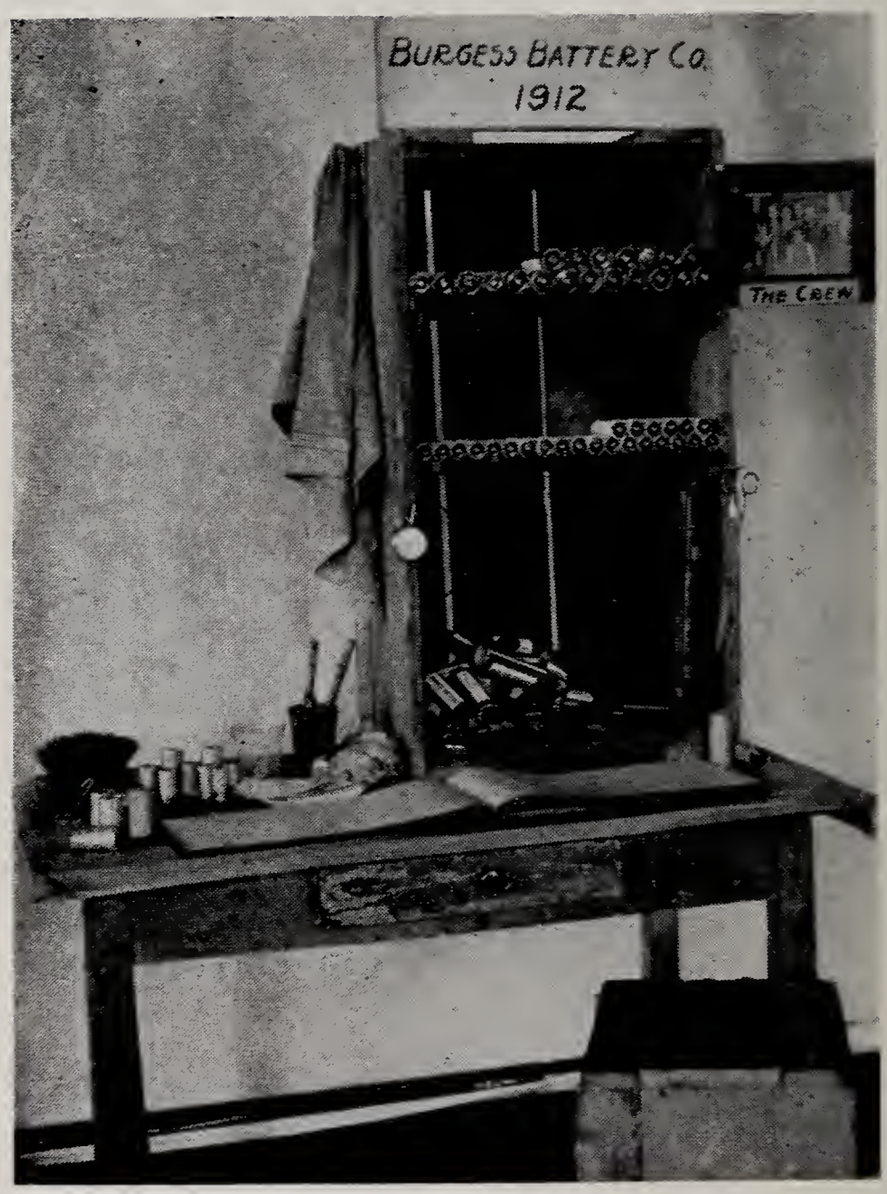
> In view of my eighteen years of continual connection with the Engineering College, it is with reluctance that I shall present my resignation. The fact that there is a rapid development in Chemical Engineering, and that there is promise of the development of a large Chemical Engineering Department in this university, makes it especially difficult for me to leave the work; and even though I may have no official connection therewith I hope I may have opportunity to be of service in promoting the interests of our Engineering College.

The expression "I *shall* present my resignation" was probably used because he did not want it to become effective before July 1. Furthermore, he was not going to leave without giving a word of advice; and he continues:

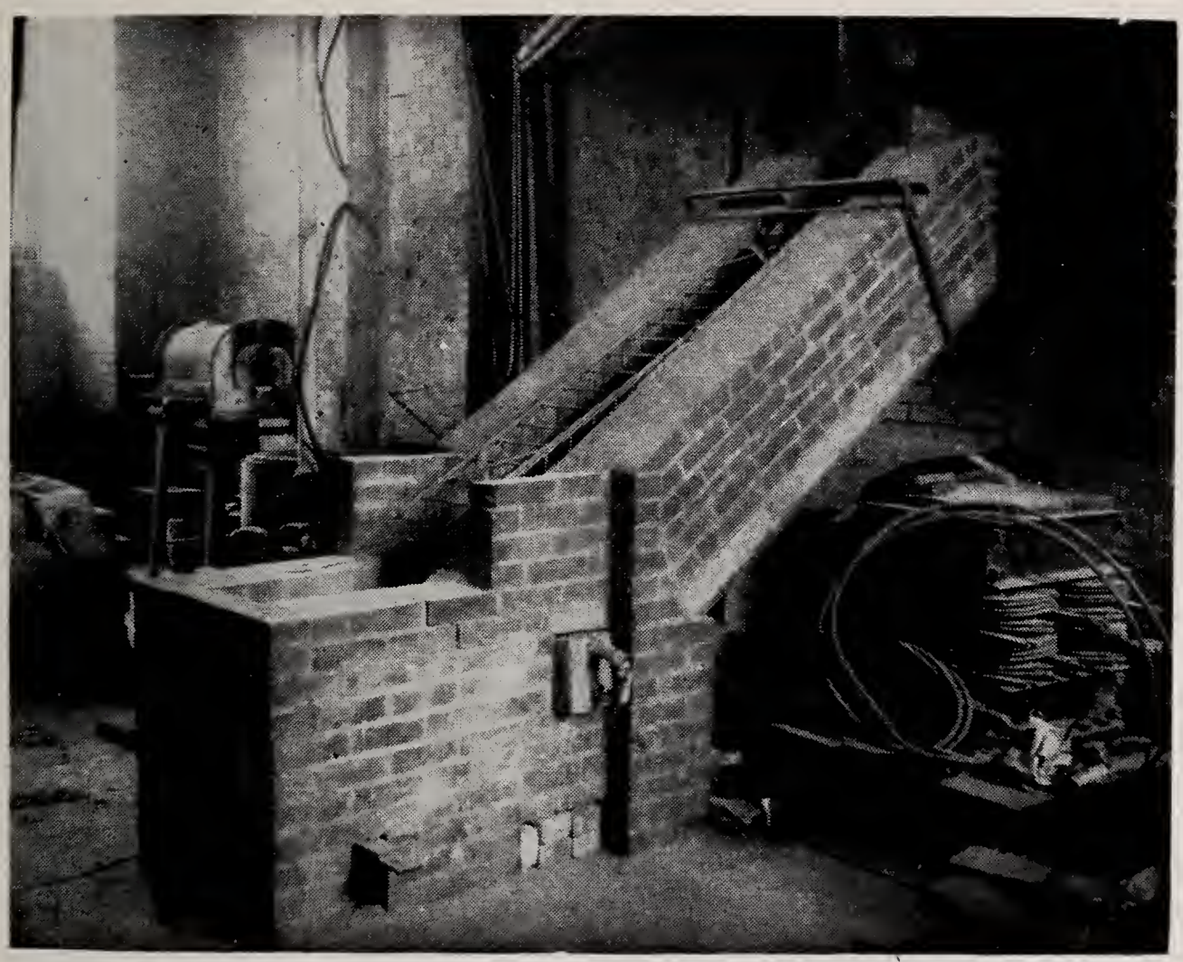
> As having an important bearing on the future development of the Chemical Engineering Department in our college, I wish to call your attention to a certain problem, or matter of policy, which will call for a settlement before a great while. Until this is done there is bound to be a duplication of effort, needless expenditure of time and money, and differences of opinion which will lead to inefficiency.
>
> I refer to the overlapping in the field of Mining and Metallurgy and that of Chemical Engineering. For example, Metallography is closely allied to, if not indeed a part of, Metallurgy. Metallurgy of Iron and Steel cannot be taught as a scientific study without at the same time dealing with Metallography. Pyrometry is the fundamental study on which industrial thermal chemistry is based; and to offer studies in furnace operations without these fundamentals would involve the teaching of practice technique, which I believe to be outside the province of an undergraduate course.

The overlapping and duplication of effort referred to by Burgess were the outgrowth of conditions as they had existed at the University in 1908. It was in that year that James Aston went to Wisconsin to assist Burgess in his work under the Carnegie grant. Because Aston was skilled in metallography and the metallurgy of iron and steel, Burgess promptly started offering courses in these subjects, taught by Aston. This seemed to fit in with the work done under the Carnegie grant on electrolytic iron, and taken by itself the move was perfectly natural. However, in the same year, 1908, Professor Edwin C. Holden, who had been engaged in the management of mines and as a consulting engineer, was called to Wisconsin to establish a department of mining engineering; there had previously been no such department at Wisconsin. Professor Holden wanted to have a well-rounded-out department, and it was natural for him to ask that the teaching of metallurgy of iron and steel be handled by his department, along with the metallurgy of other metals. But, as Burgess implies in the letter just quoted, if the mining department took over the metallurgy of iron and steel, it would also have to take over some of the related subjects, such as metallography and possibly pyrometry; and that might interfere with the smooth carrying forward of some of Burgess's plans. The conflict between the two departments continued for many years after Burgess left the University.

Burgess felt it his bounden duty to offer his parting words of counsel. He believed that the adoption of his suggestions would make for better teaching and better learning. No matter what would happen to Charles F. Burgess, he would always be a teacher at heart. Years later, when he wrote to his old friend Harry A. Curtis, congratulating him on becoming Dean of the College of Engineering at the University of Missouri, he said:



Laboratories' Battery Testing Laboratory in 1912



Special Electric Furnace for Treating Zinc Ores 1910-1912

Frederick Burgess and Three Sons

> Having had many years of experience in educational, in industrial, and in administrative work, I can say that I derived the greatest amount of pleasure and satisfaction while in the educational field.

After July 1, effective date of the resignation, there was a long silence. Burgess was appointed lecturer on a special basis at $1,000 for the year 1913-1914, but nothing was said about his resignation. Burgess said something about it to his friend Dean Turneaure, who wrote on September 3, "I am sure you understand with what regret we accept your resignation, but I hope we may have the benefit of your association at frequent intervals." Some time later, in the Dean's annual printed letter to the Alumni of the College of Engineering, he said:

> To the great regret of the faculty and alumni, Professor C. F. Burgess, who has been a teacher in the University for eighteen years, has resigned in order to devote his entire time to his large professional practice. He still resides in Madison, and the college expects to have the benefit of his advice from time to time.
>
> The department of chemical engineering has been placed in charge of Associate Professor O. L. Kowalke.

Less formal was a farewell dinner given by the faculty of the College of Engineering, on which occasion the spirit moved Otto Kowalke to chant his colleague's deeds in lively verse:

> I've been here eighteen years b'Gosh
> and started the Chemicals well;
> I've rectified the A. C. juice,
> and made *the* flashlight cell.
> I've tried to stop the iron rust,
> and gained some national fame;
> And now I think I've earned some rest
> and I'm going to quit the game.

This time he really was quitting the game. As he had written to his friend W. G. Wilcox, "After the end of this year I am not going to be a professor." This seemed to hark back to the early days of his married life, when Ida had teased him by referring to him as "Professor Burgess." "Don't do that," he used to say; "don't call me professor." . . . Now with Ida and the children, he came to meet the elder LaFollette at a reception at the State Capitol; and the moment had arrived when the Senator stooped to shake hands with Betty, who was ahead in the line. "Well, Betty," said the former Governor, "I don't see you so much any more. How is your father?" Betty hastened to explain. "Dad used to be a professor," said she, "but now he's gone to work."

19.

Burgess and His Students

WHEN Burgess said "I am not going to be a professor," he was stating a fact; but it was a fact largely ignored by his former students, who never ceased to think of him as a respected and beloved teacher. These men averaged high in records of accomplishment; and with some of them he kept up a friendly correspondence through the years. He always liked to hear what they were doing; he was always ready to help them with encouragement and advice.

One piece of advice, many times repeated, might be summarized in the words, "Don't be too hasty about changing positions; stay where you are; you are getting valuable experience." Looking through the old correspondence files, one gets the impression that graduates employed by industrial concerns were constantly writing to Professor Burgess complaining that they were being underpaid, or that they were being kept busy on work that did not seem to promise much reward. Clarence I. Zimmerman '03, one of the early electrochemical graduates—a very capable young man—must have made such a complaint, for on February 20, 1907 he received the inevitable answer, urging patience, and assuring him that he was getting experience which "in some future day may have a money value."

Similar was the case of Carl Hambuechen when, in 1904, he left Burgess to work for the Pittsburgh Reduction Co. in East St. Louis. A contemporary recalls that "Hambuechen acted like an engineer who was on his first job after getting out of school, because it was not long before he was writing back to C. F. wanting another job." Burgess gave the same advice he had given to others, and, as we know, Hambuechen stuck to his job and soon made real progress. Burgess often used the experience of Hambuechen as an example, when writing to others who wanted to change jobs too soon.

Edward Zaremba '04 exchanged many letters with his former teacher; he had done thesis work on evaporating machinery of the type devised by Magnus Swenson, and in the course of time he started his own company. In 1916 Burgess became a director of the Zaremba Company. He had purchased stock in the company "when it was still a gamble," not because of any real appraisal of the business—although there did seem to be a future in the field—but because he was attracted to young Zaremba. In the early days of the business Burgess gave a great deal of

technical assistance to Zaremba, and in other ways helped him to put the enterprise on a firm foundation.

Several of the letters are from Edward Wray '05, later successful in the industrial publishing field. Recalling his student days, Mr. Wray offers a word of tribute:

> In his classes Professor Burgess always held his students' interest very closely, both because of his brilliant mind, keen wit, and thorough understanding of his subject, and of his frequent stories of his contacts with the outside practical world.

Louis E. Ward '07 went to work for the Dow Chemical Company, at Midland, Michigan. Herbert H. Dow, head of the company, had asked Burgess to send him a promising electrochemical graduate, and Ward won the position. Again a worthwhile job did not at first seem very attractive; Ward was soon wondering if he had any future, and Burgess, privately discussing the matter with his good friend Herbert Dow, was soon giving the customary advice—"sit tight, and you'll not regret it." Ward did not exactly sit tight. He changed jobs several times within the next nine years, but returned to the fold about 1916, and over thirty years later he was still with Dow, one of a group of men "especially noted in the early history of the American Magnesium industry."

Alcan Hirsch '08, who had pursued some of his studies under Burgess, and who often compared notes with him in later years, became known internationally as a consulting chemical engineer; as early as 1913 he received the Carnegie Award of the British Iron and Steel Institute.

Arthur W. Hoffmann '08 was a chemical engineering graduate who did *not* seek a new job in his first year of employment. From time to time he wrote to Burgess, reporting progress in his work. This pleased Burgess very much; on September 7, 1915, he wrote Hoffmann, "It is a rare treat to get a letter from a former student which is not accompanied with a request for a job or for some kind of assistance. I am, of course, always glad to give assistance where I can, but it is a pleasure occasionally to run across a man who does not seem to need it." A couple of years later, Burgess voluntarily referred Hoffmann to an opening which was available at the Kimberly-Clark Corporation. When Hoffmann got the job and wrote a letter of appreciation, Burgess replied, October 23, 1917, "It is rather unusual to have a letter of appreciation such as you write."

John H. Thickens '08, who had both studied with Burgess and worked for him, wrote a number of letters. In one of these, dated August 30, 1934, he said:

> I have always felt that the training I received when I was working for you had much to do with such success as I have had in the operation of the various properties of which I have had charge.
>
> Mrs. Thickens and I frequently speak of the time when we were married, 26 years ago, and of your kindness to us then. I know that the salary you paid me in those early days was much more of a strain on you than any salary I received from others at later dates.

Thickens was living at Laurel, Miss., where he held an important post with the Masonite Corporation. In 1941 Burgess visited Mr. and

Mrs. Thickens, and on May 9th of that year he wrote:

> I got a good deal of benefit out of our visit, not only pleasure, but a kind of rejuvenation; for it recalled the old days at Wisconsin; it gave me a sample of the reward which comes to professors in observing that their boys are getting on in the world. Of the hundreds of fellows with whom I came in contact in my eighteen years of teaching, I do not know of any who have made a greater success than that which you have earned.

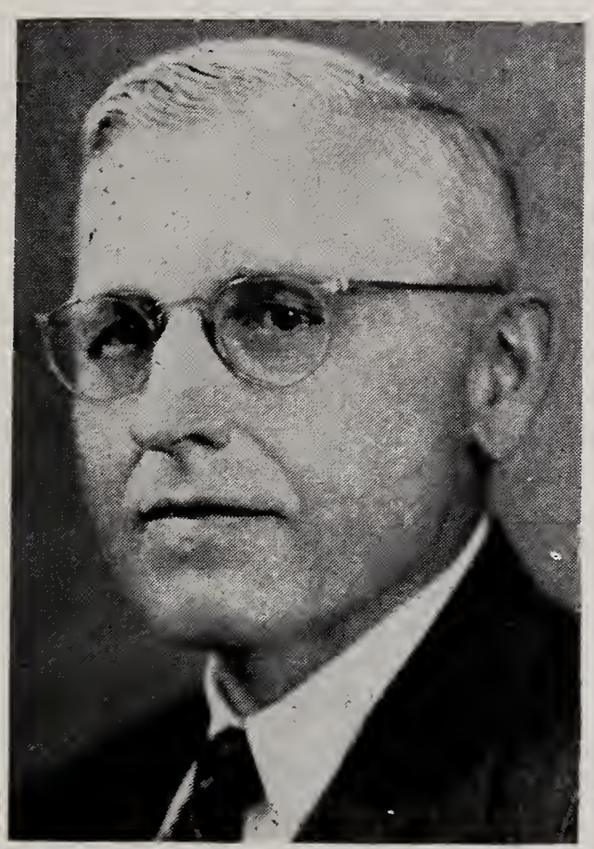
H. M. Harker, of Cedar Falls, Iowa, had his studies at Wisconsin interrupted, apparently by ill health. Professor Burgess helped him out by asking him to prepare some sort of report, and rewarding him with a fee of $45.00. November 27, 1911, Harker wrote:

> I am feeling fine, and hope to get back in school in February. If possible I want to pay my own way for the rest of the course. Would you advise staying out and trying to get sufficient funds first, or borrowing money if possible?

Burgess replied by return mail. It was a "good question," one that he was glad to answer:

> You ask my advice about borrowing money or earning it before spending it on a college course.
>
> In my opinion, the sooner a man can get clear of his college work the better, and it is entirely justifiable to borrow money for this purpose. I would recommend, therefore, that you borrow the funds that you will need rather than try to earn the money, should it interfere with your college work.

Not only Burgess's former students wrote to him. He received letters from young fellows who had never been enrolled in his classes; from some indeed who had never seen him. One day an inquiry came to him at the Battery Company office from a student named Adrian Lammers, who had conceived the idea of combining a small flashlight with a pistol, thus enabling officers of the law to see what they were shooting at by night. The young man's letter was courteously acknowledged, with the promise that a report would be made to him on the value of his invention. The report was unfavorable, but it was made in a manner not at all discouraging. The inventor was invited to come over and receive it in person. Dr. Burgess praised the device, saying that he always welcomed new ways of using flashlights; also that the suggested device was neat and usable. Unfortunately the general idea was already covered by patents, particularly by one involving the use of a portable electric light attached to a rifle. Mr. Lammers still remembers C. F. Burgess as a busy executive who was not too busy to sit down with a stranger, patiently lay before him the results of a search in the Patent Office, and kindly explain to him the fact that such disappointments were "all in a day's work." Some men would have disposed of the matter with a letter as impersonal as a rejection slip. But not Burgess; he liked to greet a failure as a step toward success. Adrian Lammers gained success in another field; but in his memories the name of Burgess remained, a symbol of encouragement and friendship.



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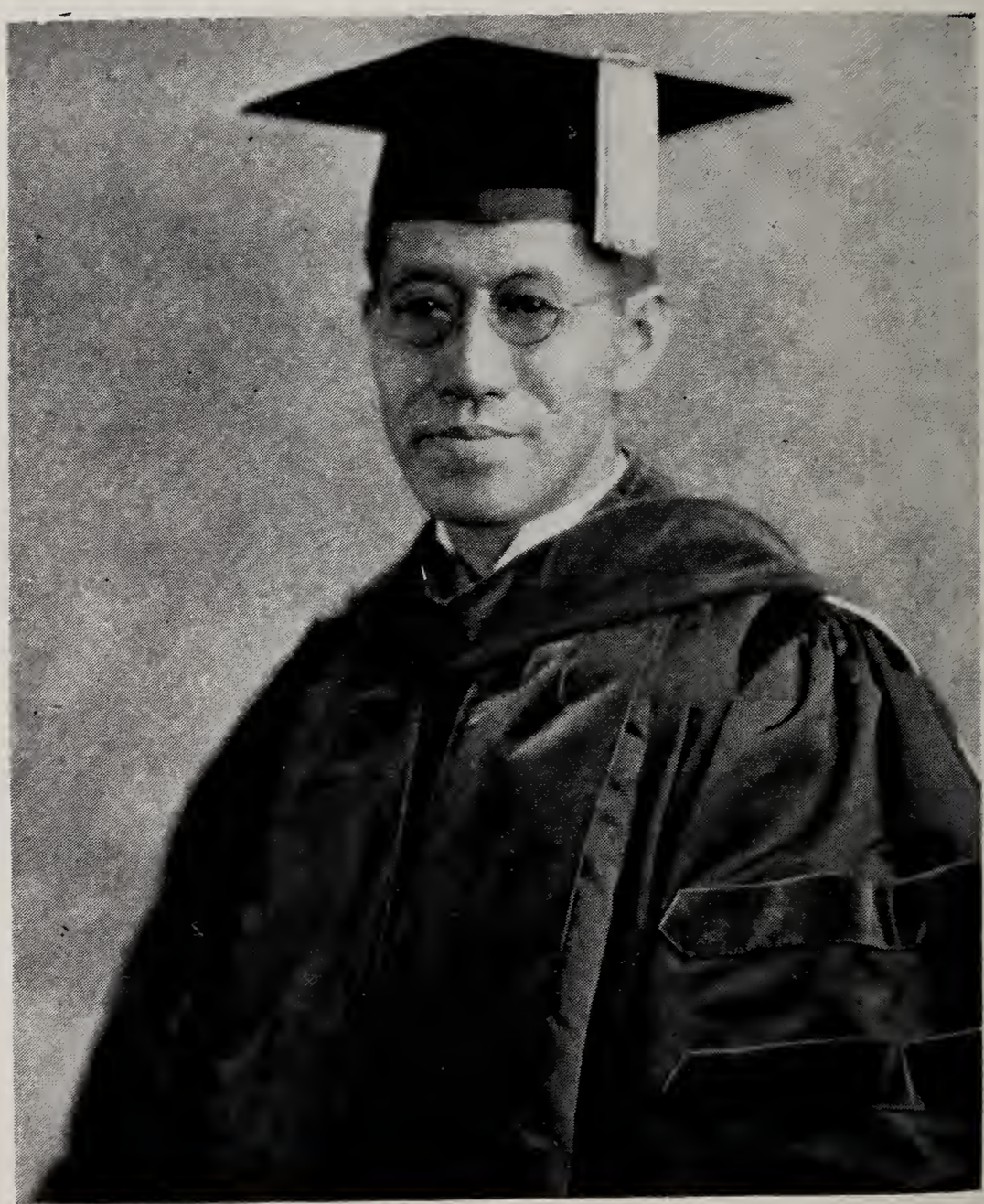


Dr. Fusanobu Isobe (1931—at the time he received honorary degree from University of Indiana)

This spirit of encouragement was a living and lasting force in the careers of many who came under the Burgess spell—students and faculty colleagues, employees and business associates. They received more than inspiration; they imbibed habits of thought and action which were to help them in solving their own problems. Perhaps one lesson they all learned from Burgess was the lesson that no amount of scholarship, no degree of business ability, can be properly effective without the knack of working harmoniously with others. In his own career, as told later on, Burgess sometimes achieved harmony by boldly cutting loose from an associate, so that each could sing a different tune without producing discord. In this way the *principle* of harmony could be maintained, and old friendships could be continued on a new and lasting basis.

Many friendships lasted through the years without change or interruption. Such a bond united Burgess with Dr. Oliver P. Watts, the "older man" who has been mentioned as an occasional guest of Charles and Ida from the earliest days of their housekeeping. In a letter written July 16, 1942, Dr. Watts recalled how he had come from Massachusetts for a year's study of electrochemistry under Burgess, and then had "become so fascinated" that he stayed another year for his Ph.D. Then, he went on:

> Then you offered me a job in producing electrically refined iron; and when Zimmerman left as Lab. instructor, you offered me a choice between the instructorship and the refining job.
>
> I chose the permanent one—which it proved to be, until I passed the age limit for teaching—and even after that I was allowed to keep my research lab., so I have an absorbing interest in life, at a time when most men are left with no absorbing interest or occupation.
>
> Without your instruction in electrochemistry I could have had none of this, and my old age would be a bore, instead of crowded with interesting things to do. So, when St. Peter stops you at the Golden Gates (many years hence, I hope), and asks you what you have done that you should be allowed to enter, just tell him what you have done for me and my life! That should get you by.

Burgess was pleased and inspired. Pleased because he had indeed been able to serve a friend, inspired because that friend—his elder by several years—was now enjoying freedom of research. Just what he wanted for himself! Sometimes he let letters lie around for weeks, or even months, without acknowledgment; this one he answered on the day it came. He wrote of old memories revived by Watts' letter, and then discussed his own plans and the philosophy that lay behind them:

> It is certainly more important to acquire a love for one's work and the friendship of one's associates than it is to acquire what we are accustomed to call "wealth."
>
> I am getting ready to pass the age limit, and will, therefore, soon be in your classification. I am sure that I will have plenty to interest me if, like you, I can keep a few electrolytic cells in operation and watch the peculiar antics of the ions.

So the teacher-student relationship, established at Wisconsin, was kept alive in many places and for many years. It was a source of pleasure and inspiration to Burgess and his classroom friends alike.

20.

Activities of Laboratories 1910-1918 and Other Early Industrial Ventures

WHEN Betty Burgess said of her father, "Now he's gone to work" (chapter 18), she knew what she meant; and so do we. We also know that in another sense Betty's father had gone to work many years earlier. In our study of his boyhood and youth we have seen him selling newspapers, climbing electric-light poles, tending furnaces, winding armatures. Throughout his teaching days we have seen him eking out his salary with outside activities. By 1910 these activities led to the formation of the commercial laboratories which now, in 1913, were to receive his undivided attention. Before sketching the history of Burgess's "Northern Chemical Engineering Laboratories," let us recall a few more of his earlier adventures in research and development. Many of them were small; all of them were interesting, and they were surely varied in nature and in scope.

In October 1902 a client had been referred to Burgess by Miss Ida May Jackson, who was soon to become his wife. In his letter of thanks he addressed her as "My dear Miss Factory Inspector," which was appropriate, for it was while inspecting the plant of the Wiesen Heel Company in Milwaukee that she had recommended Professor Burgess as an expert on heels, in this case aluminum ones. Samples of the heels were promptly mailed to the professor with the request that he devise means for gold plating them so that the gold would adhere firmly to the aluminum, though experts had insisted that no method was known for making any kind of electroplated metal adhere firmly to aluminum. Although Burgess was not able to make the gold adhere directly to the aluminum, he and Hambuechen devised a method, after considerable research, of so treating the aluminum surface that they could plate an adherent coating of zinc onto it,[37] and then plate the gold onto the zinc.

So far, so good. But these were dancing slippers, and they would have to meet the ballroom test. And right at this point we quote from a popular version of the incident which contains less truth than poetry:

> A fair tester was chosen; her name is lost to history (it may have been Cinderella), but it is known that she danced willingly; and, so the story goes, "by midnight she had danced the gold away."

It wasn't really as exciting as that. The gold did disappear, by diffusing into the zinc; but not in the course of one romantic evening. An accurate estimate would probably set the period as about two weeks. Anyhow, the gold definitely disappeared. But Burgess was not daunted. His next move was to insulate the gold from the zinc by interposing a thin plate of copper. So, specially treated aluminum plus zinc plus copper plus gold produced the lasting aureate hue desired.

In the days of the golden heels, people with problems or projects brought them to the University and to Professor Burgess. As long as he was a member of the faculty, he was careful to keep his private business from intruding in the field of services normally rendered by the University to the people of the State. From 1910 on, however, projects began to come naturally to "Northern Chemical Engineering Laboratories"; and when someone complained that this sounded too much like a public oration, the name began to be shortened in conversation to "the Laboratories," or even "the Labs."

One of the important projects turned over by Burgess to the Laboratories was the work for the French Battery & Carbon Company, discussed in some detail later; others had to do with such varied activities as zinc distillation, methods of coating with zinc, development of an electric vibrator, and the manufacture of silver-cleaning pans.

The silver-cleaning pan was invented about 1907 by Carl Hambuechen and Professor J. D. Phillips[260] of the University of Wisconsin. As explained by Professor Phillips, the improvement consisted of a special construction to make use of an electrolytic method for removing the tarnish from silver. Through their patent attorney the inventors submitted a set of patent application claims to the Patent Office. In due course word came from Washington that all their claims had been rejected. Because they suspected that the examiner had not understood the electrolytic principle involved, they turned for help to Professor Burgess, then President of the American Electrochemical Society.

Burgess got busy. He took one of the pans home with him for testing, and scared his wife by putting *all* her silver in it at once. "Charlie," she cried out, "Don't ruin my silver—please!" Betty, then a very little girl, never forgot the anxiety of that moment, when all of Mother's silver went into the pan. But it came out as clean as a whistle. The pan worked. Burgess prepared a new statement for the examiner of patents, explaining the invention very clearly, with the result that all the claims were granted, including a few that had seemed rather doubtful. Two patents were issued in 1910, and manufacture was entrusted to Burgess's new organization, which maintained a small machine shop at 625 Williamson Street, Madison. A sales company was formed, and pans were put on the market, and were sold to hotels and restaurants for a number of years.

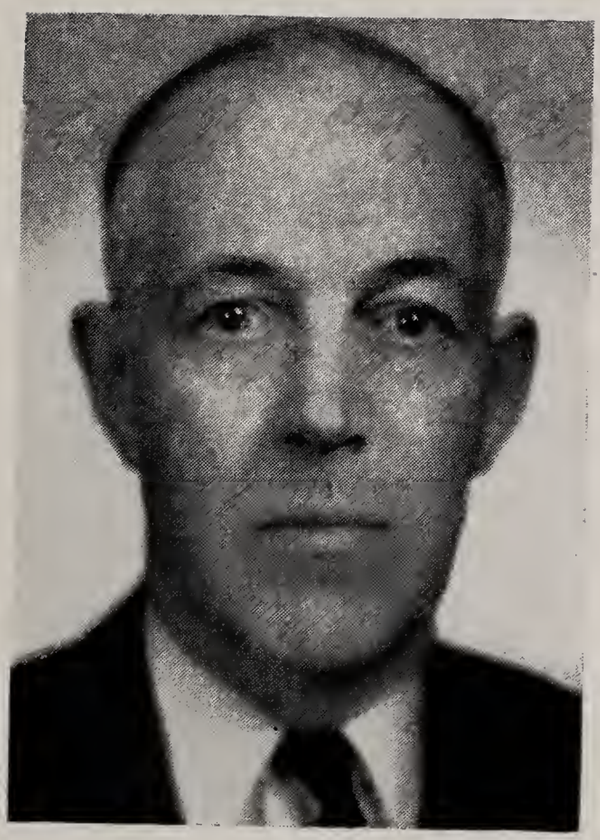
Sales dropped off badly after 1916, as the result of statements made in Bulletin No. 449 of the U. S. Department of Agriculture, entitled *Study of the Electrolytic Method of Silver Cleaning.* The implication was made that the Hambuechen-Phillips device offered no advantages over the use of an ordinary pan in which a zinc strip was placed.

An official retraction of the statement was demanded and made, but in the meantime, many sales had been lost beyond recall. The incident shook Burgess's faith in government agencies, then and ever after. The equipment eventually went out of use, as explained by Professor Phillips, "not through failure to clean silverware effectively but due to the substitution of tableware made from alloys instead of silver."

More or less related to the Laboratories for some years was a picturesque concern known as the Lorenz Model Company. Organized in 1909, this is probably the first concern of which Burgess was president. It was engaged in the manufacture of accurate models, for scientific, educational and commercial purposes. It also took on later the strangely unrelated business of making milk-sediment testers. The company was named for Ernest H. J. Lorenz, a skilled and somewhat eccentric German mechanic, who for some years had worked for the University. Back in 1904 Lorenz had gained fame by making a lifelike model of the University campus, including replicas of all the buildings, which was one of the attractions of the St. Louis Exposition. For grass Lorenz collected green fuzz from billiard tables, which he blew with bellows on to a shellacked surface. By some similar means he made natural-looking trees. A picture of the model appeared in the 1905 *Badger,* and it looks for all the world like a photograph of the University and its surroundings taken from an airplane. After 1904 Lorenz had continued to do work for the University, and often made equipment and instruments for Burgess's electrochemistry laboratories there; he also occasionally made models. From 1906 to 1909 he was an assistant in the University machine shops.

Burgess, always interested in handicrafts, conceived the idea of starting a business which would provide a wider scope for Lorenz's talents. The name originally considered was University Model Company, but "University" was dropped in favor of "Lorenz". Cooperation was given by William O. Hotchkiss '03, a former member of the Wisconsin faculty, and then State Geologist. Two other stockholders were Carl Hambuechen and Vroman Mason, the latter as secretary. The business started in the summer of 1909 in a flat above Peter Burger's hardware store on University Avenue, Madison. About a year later a move was made to the quarters of the Northern Chemical Engineering Laboratories, on Williamson Street.

Lorenz was soon busy keeping up with orders. He "made" Glacier National Park for one of the railroads, models of large areas of Wisconsin for the State Highway Department, a model of the main street of the Village of Wheaton, Illinois, "with building fronts changed so as to give them a modern appearance," a model of the proposed new Blackstone Hotel in Chicago, and many similar projects for real estate and advertising purposes. Kenneth F. Burgess, in 1910 a student in the University Law School, served for a while as business manager and bookkeeper. Late in 1911 the capital stock was reduced from $10,000 to $4,000, and Burgess, Mason and Hambuechen sold their stock interest to Mr. Hotchkiss. Lorenz eventually withdrew from the business, and activities narrowed down to the manufacture of milk-sedi-



Dr. Arlie W. Schorger

ment testers, which brought Mr. Hotchkiss a small but steady profit for about thirty years, until, as in the case of the silver-cleaning pan, the device was superseded by something new.

As we have already learned, incorporation papers of Northern Chemical Engineering Laboratories were issued November 30, 1910, thus formalizing an arrangement started in the summer by Burgess, Aston, Ruhoff and Hambuechen. Burgess liked to stress the fact that these were all Wisconsin men, and that three of them were former students of his. He liked to point out also that they had all supplemented their college training with industrial experience, summarized by him as follows:

> Hambuechen as chemist for Western Electric Co., as chemical engineer for Aluminum Co., and as assistant to C. F. Burgess in consulting and engineering work. Aston as the proprietor and manager of an iron foundry in Milwaukee, and then assistant in the extensive investigation with Burgess on electrolytic iron and iron alloys; Ruhoff as chemist with the Mineral Point Zinc Co.

The combined financial resources of these four men, including their notes drawn in favor of the new company, amounted to $9,000. "We all got help from our families," said Burgess; and years later he wrote:

> I told my father about my ideas. . . . He offered to loan me $4,000, and the First National Bank offered to loan me another $2,000, without security, relying upon my standing as a university professor to safeguard the loan.
>
> Hambuechen, Aston and Ruhoff had each a thousand dollars which they could add to mine, making a total of $9,000 with which the business was started.

The $4,000 from Frederick Burgess was handed to his son with the whimsically expressed hope that a business devoted to research might be honest.

A financial statement prepared December 1, 1910, one day after the four-month-old business had been incorporated, shows that of the $9,000 stock subscribed, only 10% was paid in cash, $500 by Ruhoff and $400 by Hambuechen. Ruhoff made up his $1,000 subscription by adding notes for $500, to be retired by services rendered to the new company. Hambuechen made up his thousand by listing $600 due him for work done up to November 30. Aston's thousand was half notes and half back pay. Burgess's $6,000 consisted of notes for $1,000, and $5,000 for assets which he had turned over to the corporation. These assets included his contract with the French Battery & Carbon Company as consulting engineer for that company, his contracts of employment with Hambuechen, Ruhoff and Maisel, a retainer from the Peoples Gas Light & Coke Company of Chicago, his interest in a 5-year lease on the property at 625-7 Williamson Street occupied by the Laboratories, and all his interest in patent rights and patent applications then being prepared or prosecuted by patent attorneys relating to (1) zinc distillation,[113] (2) methods of coating metals with zinc,[107-110] (3) electrical vibrator,[111] (4) dry cells[112] and (5) machinery for dry cells.[292]

These assets, and the money Burgess had paid for office equipment, machine shop equipment, laboratory equipment, materials, etc., were listed at $4,200, plus $800 for out-of-pocket expenses to patent attorneys already disbursed on the five projects just named. Remembering that Burgess had obtained from his father and from the bank a total of $6,000, we may assume that funds were available for a bank account; the borrowed money had been paid out for equipment.

Northern Chemical Engineering Laboratories was incorporated in Wisconsin, for $15,000. Its objects, according to the articles drawn up by Burgess's good friend Vroman Mason, were:

> To engage in expert and consulting work in all lines; to engage in experimental research work and to develop inventions and devices of whatsoever nature; the practical working out of discoveries and inventions; the securing of letters patent through purchase and sale or otherwise; and to manufacture, sell and deal in machines, appliances and merchandise of whatsoever kind and nature.

Burgess had said, "We have in prospect a considerable variety of lines of work," and Vroman Mason, soon to become a stockholder, worded the charter accordingly.

Many years later, James Aston, interviewed in Pittsburgh, told how the directors of "N.C.E.L." first came together:

> We had all been working for Burgess, independently of one another, on things he was financing himself, and on which he was doing consulting work; in my case it was work on electrolytic iron, under the Carnegie grant.
>
> But now came the Northern Chemical Engineering Laboratories, and this was the first real grouping of activities. Burgess was President, I was Vice-President, Ruhoff Secretary and Carl Hambuechen Treasurer; the four of us all had titles.

More important than their titles was their ability. Without ability the four of them would not have come together; Burgess was impatient with titles—even the highest scholastic ones—unless accompanied by the capacity to get things done. His own ability was recognized in a new and gratifying manner at about this time, when the 1910 edition of *American Men of Science* came out, with the notation "*Electrochemistry" appended to his name, the asterisk indicating that he was one of America's leading scientists and eminent in his field.

In the spring of 1911, when work began to pile up, Burgess looked around for a man worthy to go down in history as first employee of the organization's technical staff. The search was not a long one; in his years of service as a one-man employment agency he had learned where likely material was to be found; the choice fell on one of his own students, Walter B. Schulte '10, who had just received the advanced degree of Chemical Engineer. Schulte, not yet 23, must have been "rarin' to go." Having duly celebrated the Fourth of July, he rose early next morning and reported for work one hour ahead of time. Said he to one of his friends, "The place didn't open till eight A.M., but I was there at seven." Whether done by design or by accident, it was just the

thing to make a hit with Burgess, whose dream of the ideal worker was one willing to come early and stay late. It was a propitious beginning to a long and worth-while connection.

Bookkeeping and stenographic work was taken care of by Miss Ruth Bramhall, who had been Burgess's secretary for several years, and who stayed with the Laboratories until 1913.

In August 1912 the Laboratories parted with their first Vice-President. James Aston left, to accept a much more remunerative post as Professor of Metallurgy at the University of Cincinnati. He left with reluctance, but felt that he ought not to pass up this opportunity to serve under Dean Herman Schneider, famed head of the College of Engineering and Commerce at Cincinnati. Herman Schneider was interested in Wisconsin; in 1903, when he was at Lehigh, he had accepted a call from Dean Turneaure to go to Madison and teach civil engineering; but he had been released from that obligation so that he might take the Cincinnati post, which seemed to offer a better outlet for his talents. Nevertheless he had kept in touch with Wisconsin; and now he was taking Aston.

Aston's resignation upset Burgess's plans for the development and manufacture of electrolytic iron and alloys; these plans were never revived. At the Laboratories Aston had been doing valuable work, which now would have to be dropped or assumed by others. He had also been an instructor in the Chemical Engineering Department at Wisconsin, and his instructional work would now have to be taken over by Burgess. With so much pressure, something had to give. On October 1, 1912, as the Fall Semester opened, Burgess acted. The nature of his action can best be told in his words, in a message to his associates at the Laboratories:

> I am submitting, by this letter, my resignation as an employee of the Northern Chemical Engineering Laboratories receiving salary for service. This step is necessary due largely to the pressure of university affairs and the necessity for taking on additional instructional work, due to the leaving of Mr. Aston.
>
> I propose to continue service as president of the Company, will act as advisory and consulting engineer, and will make no charge for services in connection with the general management of the Company, or for work done in connection with patent matters for which application for patents has been made.
>
> With the expectation that future developments will enable me to get back on a regular employment basis, I will keep track of expenditures made on any development work which I may do, so that this can be transferred to the Laboratories, if desired. It is my hope and expectation therefore that this arrangement will be a temporary one.
>
> I shall expect that any work which is done on my request to order shall be charged to me at the regular rates for time and material plus overhead, and that a reasonable charge be made to me for such time as Mr. Hambuechen, Mr. Ruhoff, Mr. Schulte or Miss Bramhall may devote to my work. A schedule of rates per day or per hour for such time should be worked out.
>
> It is my intention to have Miss Weisman work for me personally and under my pay.
>
> Signed: C. F. Burgess

Perhaps the most significant paragraph in this letter is the third, stressing the thought that the arrangement outlined was only temporary. Within a few weeks the directors of N.C.E.L. were to double their capitalization, and then to welcome James B. Ramsay, Vroman Mason and Walter B. Schulte as additional stockholders. In January 1913 the authorized capital stock was more than doubled, from $15,000 to $40,000. This added capitalization recognized that the assets of the Laboratories had, in about two years, increased to double the amount of the original capitalization, and furthermore provided for the sale of stock to the new stockholders to increase the working capital.

In 1912 a new honor came to Burgess, when the Western Society of Engineers awarded him the Octave Chanute Medal, for a paper, "Electrolytic Corrosion of Iron in Concrete,"[35] presented to the Society in 1911. Early in 1913 the Chicago branch of the National Electro Platers Association notified Burgess that he and Dr. O. P. Watts had been elected honorary members of the branch. This friendly gesture was prized highly, because these electroplaters were practical men in the shops, and their action proved that they recognized the value of scientific research as applied to the processes of their work. Soon afterwards the National Electro Platers Association became the American Electro-Platers' Society, and again Burgess and Watts received honorary membership, this time nationwide, in the new organization. They shared the honor with several other prominent men, including Burgess's old acquaintance Professor Joseph W. Richards, of Lehigh, and Dr. George F. Kunz of Tiffany & Co., writer of many books on the lore of precious stones. Burgess and Watts never lost touch with progress in the electroplating field, and Watts earned the lasting gratitude of the trade by working out an improved high-speed method of nickel plating on iron and steel which is still known as the Watts Bath.

On July 1, 1913, as we have already learned, Burgess resigned from the University faculty. Then to 625 Williamson Street came Miss Bertha Weisman, who had worked in his office at the University, there taking care of much of his correspondence. As stenographer, as private secretary, as bookkeeper, as stockholder, as loyal helper in a hundred ways, Miss Weisman made a place for herself with the Laboratories, and filled that place efficiently and well for more years than she or any other members of the group in 1913 could have imagined.

The Laboratories continued to be busy; and on July 22, 1913, as if to provide Burgess with an added means of keeping busy, his friend Howard F. Weiss appointed him as expert in the U.S. Forest Products Laboratory. The pay accompanying this appointment was only $10.00 "for each day worked," but as with so many of Burgess's connections, the pay was not the thing. In view of later happenings it is interesting to note that the Forest Products Laboratory, of the Forest Service, U. S. Department of Agriculture, had its official opening in Madison in June 1910—the same month in which Burgess's own Laboratories began to function. The first Director of Forest Products was McGarvey Cline. One of its assistant directors was Howard F. Weiss, who very soon formed a close friendship with Burgess as also did Carlile P. Winslow,

its Engineer in Wood Preservation. In 1912 Weiss became director, and one of his first official acts was to make Burgess a Forest Products consultant. The practical and eminently useful research carried on by the Forest Products Laboratory was delightful to Burgess, who was never happier than when finding out how to make use of things formerly considered useless.

Burgess's friends often wondered why he did certain things. Some of them probably wondered why, late in 1913, he moved his family from what he called "a lovely old rambling stone house" on East Gorham Street, to cramped quarters in a hotel; and why, only a few weeks later, he moved them again to a small apartment on East Wilson Street, where for over a year they lived in a state of constant inconvenience. Burgess had not planned it that way. He had expected that early in 1914 he would be able to move his family, and his business, to Chicago, where he had arranged to establish a "Burgess Battery Company" for the manufacture of flashlight cells. A site near the Chicago "Loop" had been chosen for office and factory, and James B. Ramsay had apparently agreed to accept the position of general manager. Burgess had prepared the manuscript for a prospectus, and was planning to sell stock. Then Ramsay changed his mind; he decided he did not want to leave Madison. Plans for the new company were postponed indefinitely, and the Burgesses did not go to Chicago. By April 1915 Burgess was able to write to a friend, "My family is now located in a residence at 416 N. Livingston Street. We have more room than we did before."

More room at home, more work at the Laboratories. From 1914 on, the manufacturing end of the business increased so rapidly that there was no longer any financial need for taking on consulting jobs. In 1914, therefore, Burgess began turning down such jobs. He made some exceptions, when the work was especially interesting, or when it was brought to him by any of his early clients; he remembered the days when such clients had been friends in need, and he never forgot them. In general, however, the time had come when consulting work was to play a very minor role.

Important in the routine of the Laboratories was the custom of keeping notes. This custom was established by Arba B. Marvin at the birth of the Laboratories in 1910. All key men were required to keep "a daily record of data, observations, actual happenings, new ideas and facts" relating to their work. Anyone familiar with the drama of patent history, where grave legal and technical decisions have often depended on a scrap of paper and a few hastily-written words, will see at once the value of daily records, detailed, definite and dated. Mr. Marvin, as patent attorney for the Laboratories, was asked to draw up a manual of instructions on the keeping of notebooks, the writing of reports, and the use of the library and patent literature. In an article written some years later,[71] Burgess said:

> The instructions were intended primarily for employees doing research, experimental and development work. However, the general instructions then issued now apply to notebooks kept by plant and office men of our affiliated companies as well.

> The manual states that each notebook given to an employee is numbered and is the property of the company. At the close of each day, and before leaving the offices or laboratories, every notebook possessor is expected to make entry of all important features of his work which occurred during the day. This should include not only record data, but a brief memorandum of any new ideas discovered either by himself or his associates; conferences of any importance, giving the names of those present and the subject discussed; observation on any new process, product, machine, mechanical device, merchandising plan, advertising program, and so on.

Some men—including some of the brainiest—are just naturally not good note-keepers, and the records varied in quality and quantity. But Burgess kept after all careless or neglectful diarists, and insisted that they co-operate. In the article just mentioned he wrote:

> The man who omits his notes is usually careless of other obligations. He is usually marking time, and a time-marker is not a useful employee.
>
> One of the best kinds of insurance which a company can take out for its own benefit is the time and money invested in maintaining notebooks. It usually takes from ten to twenty minutes per day. This time becomes especially valuable because a man cannot write without thinking. Several employees have told me that some of their best ideas have been evolved and perfected by writing of them.

Burgess's own notes, kept in varying forms throughout the years, sometimes listed the hours spent with his family. In a little red book labeled *1914,* he noted down on April 15, "4-6 P.M., with kids, boating"; and on May 3 he wrote "Took kids to Hillside Academy." This was the Hillside Home School, at Spring Green, Wisconsin, conducted by the Misses Lloyd-Jones, where Betty and Jack received some of their early education. The first school buildings had been designed about 27 years earlier by an 18-year-old nephew of the Lloyd-Jones ladies, a student of civil engineering at Wisconsin under Professors Storm Bull and Allan D. Conover. In 1903 a beautiful building of native limestone had been added by the same nephew; his name was Frank Lloyd Wright. Carved in stone over the great fireplace in the study room was the old Welsh motto of the school, "Y Gwir yn erbyn y byd"—Truth against the world. Years later, on the same site, world-famed architect Frank Lloyd Wright was to conduct the Taliesin Fellowship, a school of another kind, though with the same motto, where truth against the world was taught in architecture.

One day in 1914, when Jack was not quite seven, a letter came to him addressed "Mr. Jackson Burgess, Hillside Home School, *String Bean,* Wisconsin." It was from his irrepressible uncle, Charles Tenney Jackson, who had just finished work on his novel *The Fountain of Youth.* Everyone, including the postmaster, enjoyed the string-bean joke.

Burgess's little red book for 1914 contains some revealing notations; for example, the following:

May 13:	8-9	Miscell.
	9-10	Conference with Nutting in Green Bay water case
	10-1	Drawing up agreements with F. B. Company
	2-4:30	Uncle Dick's Funeral
	4:30-6	Lab. Miscell.
	7:30-11	Directors meeting of B. of C.

Presumably after the "F. B." entry, referring to agreements with the French Battery & Carbon Company, Burgess went home for lunch and then, with his wife, attended Uncle Dick's funeral. "Uncle Dick" Petherick was no relative; he was "a dear old man" who had written a column for the *Milwaukee Journal* in the Nineties, and been kind to Ida May Jackson in her early newspaper days. In his closing years Uncle Dick, beloved by all, had been given an easy job on the State Board of Controls. "B. of C." refers to the Madison Board of Commerce.

Early in 1915 Burgess became interested in a correspondence course in the Science of Business Building offered by the Sheldon School, of Chicago. With some of his associates he organized a club of five to take the course, and on March 5 he wrote the school saying "I am sending herewith answers to Lesson 1." His answers, which are still preserved, were models of scholarship and correctness, and came back marked "Excellent," with a further comment that "we expect to see you get the maximum profit from this course of study." A month passed by, and no more answers came. A polite educational director at the school wrote:

> Dear Mr. Burgess:
>
> Is your paper on Lesson 2 almost ready to send in? Perhaps you do not realize that nearly a month has gone by since your paper on Lesson One was received. Do not let the work get behind; try to send in a lesson paper once every two weeks.

A year passed by, and the school was still writing, not so hopefully, "We are sorry that your name does not appear on our list of graduates." One of the school's most eminent students had stopped with the first lesson. But the incident is not so absurd as it might seem. Burgess was so busy *building business* that he had no time to study business building. He evidently realized this almost at the outset, and calmly decided to get along without the aid of the course. That he did get along pretty well is proved by the fact that during 1915 the Laboratories' employees increased from 40 to 150.

Discussing the somewhat unwieldy name of his organization, Northern Chemical Engineering Laboratories, Burgess once explained that he chose it for mixed reasons, partly for modesty but mainly to avoid undue commercial exploitation of his name while he held an important post at the University. When he "quit being a professor and went to work," at least one of these objections did not hold, and early in 1915 it was decided to simplify the name to C. F. Burgess Laboratories, which change took place on March 2. Later in the year came another change,

for which Burgess and his friends were totally unprepared. On the evening of December 1, the day after they had celebrated the fifth anniversary of the Laboratories, they suffered a severe loss by fire at the plant of the French Battery & Carbon Company, on Dickinson Street, where flashlight cells were being made by the Laboratories. Details of this disaster, and of the means taken by the Laboratories to recover from its effects, will be found in the "battery" story in later chapters. It is enough now to say that this was a period of moving, of renting, and of planning.

One of the symptoms of this period of change was the opening of an office in Chicago, "in a little interior cubby hole without any windows" in what is now the Commonwealth Edison Building. It was in charge of Duncan Keith, friend of Burgess's early boyhood. By February 1916 the Chicago office had grown to three office rooms in the Harris Trust Building. In February also came another change, when Secretary Otto Ruhoff resigned from the Laboratories and went to work for the French Battery & Carbon Company, for which he had already been working secretly, with later sad results for both concerns.

Meanwhile, in spite of fires, or movings, or resignations, the Burgess interests were making progress. Assets had grown to about $80,000, and on March 25 the capitalization of the Laboratories was again increased; this time from $40,000 to $100,000. The extra $20,000 was needed to take care of increasing business. At the same time the articles of incorporation were amended, "to enlarge the business and purposes of said corporation to include the business of mining and treatment of mining products." The world had been at war for twenty months, and something would have to be done to find important raw materials in America, formerly imported from Europe. The Burgess adventures in mining deserve a chapter to themselves; they were part of the national movement toward industrial preparedness; and on the last day of March, Burgess became a part of that movement officially, when the Secretary of the Navy made him a member of the Board of Industrial Preparedness for the State of Wisconsin, and Associate Member of the Naval Consulting Board. To Burgess such an appointment was not merely a decoration; it was a call to work. He answered it by giving freely of his time and talents, and by insisting upon speedy translation of words into deeds. In June he hurried to New York for a meeting of former presidents of the American Electrochemical Society, to consider certain phases of chemical preparedness; and scarcely a day went by in which he did not spend several hours in service to the nation. In July he discussed a topic of national importance in a paper read before the Wisconsin State Board of Industrial Education. This paper was entitled "The Employer's Interest in Industrial Education."

Through all these months of public storm and stress, home life and business life managed to continue more or less normally, and Burgess was duly thankful. As he wrote to his father:

> When I think of the terrible ordeals the millions of people on the other side of the globe are experiencing, those which we

> may be having appear too trivial to mention.
>
> I know that we were both lucky in getting the best wives the country affords—we are lucky in being U. S. citizens instead of Belgians—in being Republicans instead of Democrats; in fact, we have so much to be thankful for that we ought not to feel bad that we are getting old and losing our hair.
>
> We ought to be glad that we are living during one of the greatest periods of the world's history; and I hope that you and I will both live to see the world restored to a condition of tranquility.

The last hope was not fully realized. On April 28, 1916, after a short illness, Frederick Burgess died, at the age of 83. Some time before the end he had written these words:

> I don't think a man should mourn or grieve over the closing of his eyes to the things of this world. We should try to realize the fact that in parting with the things of this world we do so that we may open our eyes to a brighter more brilliant career beyond the veil that hides the future from our earthly eyes. We are only carrying out the wise designs of the all-wise ruler when we lay down the burden of this life. The leaves of this year must wither and fall to make room for next year's growth.

Two philosophers, and two worlds. The older man looking forward to new experiences in another life; the younger, still with work to do on earth.

The work on earth was important and constructive. In the Fall of 1916, the Laboratories began to build a fine new home at 1015 East Washington Avenue—a fireproof plant with plenty of floor-space for immediate use and for expansion. In choosing a marshland site for the new plant, Burgess was thrilled with the idea that he was putting what then seemed a somewhat undesirable location to good use. Perhaps an added attraction lay in the fact that the territory was overgrown with cat-tails, which brought back memories of his boyhood days.

By February 1917, after months of heavy expenditures for building and for business expansion, C. F. Burgess Laboratories was short of money. As Burgess explained to a friendly creditor, this was "due to our preparations for a much larger business which we are planning for." The friendly creditor agreed to wait, and was duly paid within two weeks, from which it may be gathered that the situation, while difficult, was not critical.

March 1, 1917, was the date of the most important event in the history of the Laboratories—the incorporation of the Burgess Battery Company. This is discussed in detail in the chapters which follow. On April 1, Howard F. Weiss resigned as director of the Forest Products Laboratory and joined the staff of C. F. Burgess Laboratories, to be followed in June by Dr. A. W. Schorger, who was highly skilled in organic chemistry, particularly in that relating to the cellulose industry. The forestry background of these two men is reflected in a 1917 summary of Laboratories research, which mentions hydrated pulps, transformed wood, western larch, fireproof lath, etc. In one of Burgess's notebooks a penciled memorandum appears, to the effect that in 1917

the Laboratories "Launched whole-heartedly on utilization of wood waste."

All activities in the latter half of the year were keyed to meet the needs of a grim national emergency, for it was on April 6, 1917, that the United States entered the World War—a war which people hoped would end all wars. In July Burgess was appointed a member of the Draft Board for Division No. 1, Western District of Wisconsin. For a year and a half the work of this office, done thoroughly and impartially, occupied an incredible number of his waking hours. He and his assistants, many of whom were patriotic women who volunteered for the work, established a record for the efficient handling of the questionnaires which poured into the board daily for several months. There were about 25,000 questionnaires, of 14 pages each, many of them accompanied by documents to support claims for exemption, in the shape of deeds, mortgages, statements of religious belief, formal petitions, prayers, and even love-letters. So arduous was the reading of this mass of human literature that one member of the board, after two months of it, lost 27 pounds in weight. Each day, said Burgess, brought its humor and its tragedy. He said little of the tragedy, but often recalled the humorous items, and quoted some amazing and amusing notations found on returned questionnaires, such as these:

a. Am a married man and can't get help.
b. My brothers, August and Fred ****, are in Bohemia, and would come and go to the allies to help fight Germany, but they have been asked to fight by the German government.
c. I work farm because of natural love and affection for my parents, and expect to receive the farm from them at a future time.
d. My father is unable to help me with work because he is dead.
e. I have a 120-acre farm and a weak stomach.
f. If this man is drafted it will be a great detriment to the maintenance of the national service, and to the * * * * Grocery Co.
g. (From a wife): If my husband is as good a fighter in the army as he is at home, his country needs him more than I do.

Burgess was proud of the record of his board, and indeed, of the work of Wisconsin draft boards generally. He often complained about the activities of a strong pro-German element in the State, but said that in spite of this, Wisconsin went over the top with its Red Cross drive, was early in meeting its Liberty Loan quota, had taken a lead in the Council for Defense, and, "without making any fuss it has been the first state to finish its draft."

While Burgess was serving thus, he had the satisfaction of knowing that the United States Government was sending some of its top engineers and chemists to his plants, to learn about new types of cells and batteries. The Burgess Battery Company had been born in a year of destiny.

21.

Early Work on Dry Batteries 1907-1913 and on Sherardizing

WE have just said that the Burgess Battery Company was "born" in 1917; but the actual making of dry batteries by Burgess and his associates had then been going on for several years. Burgess's interest in primary batteries dated back to his childhood days in Oshkosh, and grew steadily throughout his university years. At the turn of the century he wrote a pioneer article on dry cell tests,[81] based on tests made at the University under his direction by Albert A. Radtke '00.[240] His interest in this field received an important boost as the result of something that happened in 1906. Early in that year he corresponded with a newly-established battery and carbon concern in Chicago, regarding a supply of carbons for his electric furnace work. In August 1906 the firm, known as French Battery & Carbon Company, moved to Madison, and in February 1907, after a visit from its business manager, James B. Ramsay, Burgess told a friend that "the new battery company" would probably be needing some scientific aid. He was right. In April 1907 Mr. Ramsay asked for an analytical report on two samples of battery compound. Instructor O. L. Kowalke, assisting Burgess at the University, made the analyses, and submitted a report. Then, as Professor Kowalke remembers it:

> Ramsay came in to see Burgess, and said, "Well, now we have these analyses from Kowalke, but I don't believe they're right."
>
> Burgess called me in. I said, "These analyses *are* right."
>
> Burgess said to Ramsay, "How do you know they are not right?"
>
> Ramsay was ready for this question. He said, "I know because you haven't reported any mercury."
>
> I said, "There is no mercury in them," but Ramsay insisted, "I know there is."
>
> Then I said, "How do you know?", and he came back with what he felt was a perfect answer. "I know there is mercury in them, because I am paying for it."

Investigation showed that Ramsay was mistaken, Kowalke was right. The sample contained no trace of mercury, although that ingredient was needed to maintain the battery's "shelf life," or period during which it stands idle before it is put to use. The supposed expert who mixed the material for the batteries had been stealing and

selling mercury as fast as the company bought it, so none was left to put in the battery mix. Supposedly for the lack of this important element, the batteries had kept coming back; the swamp adjoining the company's plant had become a veritable graveyard of returned goods. No wonder, as stated in a letter of the period, that "the concern was running behind at the rate of several thousand dollars a month." To avoid ruin, two steps were taken: The "expert" was fired and the essential mercury was put into the mix. However, as the summer wore on the batteries did not improve, and red-ink entries in the company books continued to record a tale of loss. Then Ramsay realized that the poor quality of his batteries had been due only in part to the omission of mercury. What he needed now was a sort of electrochemical detective, a man qualified to track the trouble to its source and overcome it. In October 1907 he decided that the logical man was Professor C. F. Burgess. So it came about that Burgess, although without any practical experience in dry-cell manufacture, was put in charge.

Burgess went into this project with all his heart, and with all his cash. This was no ordinary consulting project. Because the company could not afford to pay him a consulting fee, he was to receive as his whole remuneration the privilege of buying stock in the concern at a supposedly bargain price, 10c on the dollar; whereupon, as he told later, he invested all the money he possessed, which happened to be $1,000. The company handed him 20 more shares of stock to distribute to his assistants in payment for help they might give in solving battery problems. He was soon shocked to find that his precious thousand had brought him nothing; in the opportunity to buy stock he had merely been given the privilege "of paying something for nothing in hope that it would be worth something." The company, he found, had more liabilities than assets. Some of its dry cells were so bad that they went "dead" within a week. Some were already dead at time of sale. Conditions were so deplorable that many a man in Burgess's plight would have given up in disgust. But not C. F. Burgess. In spite of all its disadvantages, this project represented opportunity. It enabled him to enter the manufacturing field and to put into practice the things he had been teaching—things in which he ardently believed. It was a golden opportunity for him to prove that a man of theory could help a man of practice. It is true that the financial setup was bad; and that virtually every move relating to the business had to be made "from scratch"; but in a penciled memoradum made some years later, Burgess said:

> This, instead of discouraging me, aroused an enthusiasm to learn a lot more about batteries—and to help make the battery business a success. Hence I devoted much time to laboratory study, with the result of development of various new ideas of moderate value.

So it was that before the close of 1907, Burgess was a stockholder and director of a concern which for its prosperity—for its solvency—depended on him. He did not know—nor did anyone else—

that he was creating a business which would in later years become the Ray-o-Vac Company. His immediate task was to bring life to the French Battery & Carbon Company. Facing this task, he did not forget his responsibility to the University of Wisconsin. As a prominent member of the faculty, he had certain duties to perform, and he continued to perform them, both directly and by means of assistants. He followed a similar policy with the "French Battery" work, in which, sooner or later, he was aided by O. L. Kowalke, John H. Thickens, Dr. O. P. Watts, Assistant Professor Judson C. Dickerman, and, above all, by Carl Hambuechen. For some time Hambuechen worked exclusively on the battery company's problems; but even before Hambuechen started, in June 1908, Burgess had been able to report progress, in a letter to his father, dated April 3, 1908:

> Perhaps you are wondering about that battery business I took up last November. Well, I found it to be in worse shape than I expected, and it has been a hard struggle for existence. The concern had never made a cent, in fact had lost over $50,000. . . . They were making the poorest battery on the market.
>
> While we are not out of the woods, things have materially improved, and I believe we will land on top. I have not become an officer, having refused the presidency, but I have a good deal to say about the management.
>
> At the present time we are, I believe, making the *best* battery in the country. Last month we ran even—the first time in the company's history. We are making about five times as many batteries per day as we were in December, and the business is steadily growing—and we will soon be up to the capacity of the plant.

Not bad, in less than six months! And all this progress was due to the fact mentioned by Burgess, that he had "a good deal to say about the management." Besides improving the product, he was reforming the company's business methods, serving as a "business engineer" years before that title found a place in the dictionary. He exercised a remarkable degree of authority in revising the methods of the French Company, and was consulted on nearly every point. The records show that his recommendations were followed in large part in the critical years 1908 and 1909. Tending to justify his authority was the fact that his income from the company depended in part on savings to be effected under his policies. After he established his own Laboratories, his services continued; and in a letter dated February 9, 1916, Mr. Ramsay stated "The French Battery and Carbon Company would not be the success that it is today, if it had not had the services of the Laboratories."

A few months after writing the cheerful letter to his father in June 1908, the enterprising Burgess sent his young brother Kenneth out on the road as one of several salesmen for the French Battery & Carbon Co. Kenneth, not yet 21, had the Burgess flair for letter-writing. He reported from Falls City, Nebraska (population 3,000):

> Find this country radically different from Wisconsin. Business here is practically in the hands of young men—fellows ranging from 24 to 35—no show out here for men who have passed that age apparently.
>
> I certainly hope that where I'm able to secure openings, you'll send them the right stuff, because if you don't it's all off; and if you do, we get the business on account of price. The other companies are selling through Chicago and Omaha jobbers, and consequently the buyers have to pay the jobbers' profits.
>
> Of course, the best I can do where F.d.L. is unknown is to secure a trial order, and where it is known, is to secure *another* trial, on the basis of our *magnificent* engineering department, "of which I was once a member"—for a week. As I'm putting my best foot forward, I usually omit the latter phrase.

Burgess believed in selling direct; the French Company assumed the functions of the jobber at a saving in cost, which saving was passed along to the retailer; so Kenneth was able to "get the business on account of price," and still sell goods of first rate quality. F.d.L. stood for Fleur de Lis, trade name of the batteries. Kenneth was working hard; this is indicated in a letter written by Burgess to his father in July 1908:

> Kenneth probably told you all about our engaging him as a traveling salesman. He was put into an extremely hard territory, and if he did not possess plenty of grit he would have let it go and gotten discouraged. But he did neither of these, and did some first-class work. This is a hard experience for him, but I believe it is a very good one. I am really very proud of him, and you have reason to be also.

Further on in the same letter Burgess has a few words to say about his principal aid in this work:

> I found I was getting so well loaded up that I was getting behind, so I engaged one of my former assistants to come to Madison and work for me. His name is Carl Hambuechen; perhaps you remember meeting him.
>
> The battery business is progressing fairly well, and I believe he will put it on its feet.

Hambuechen was entrusted with engineering work for the French Company on the standard six-inch or No. 6 cell, and he would also be able to do some development work for Burgess on a flashlight cell, in which the owners of the French Company were not interested, because of their lack of financial resources. It was one thing to produce a standard cell, and another thing entirely to produce miniature cells for flashlight use. The methods and problems involved were very different.

Flashlights had been on the market for some time, but on a visit to Chicago in April 1908 Burgess found that the gas company there was still equipping its meter readers with another type of light. This consisted of an electric torch attached by a cord to a small storage cell carried in the inspector's hip pocket. The battery was a single cell in a hard rubber case, about 1x3x8 inches. The company was using several hundred of these portable lights, which cost $5.00 apiece and

lasted about a year. One man was given the task of keeping the batteries charged and in order. Burgess immediately began to work on a small flashlight cell for this purpose. He also experimented with small batteries for hearing aids, several of which were being advertised; this interest was in part due to the fact that his father was hard of hearing. Burgess liked to tell how his first small cells were made in two sizes, No. 1 and No. 2, "the sizes being set by the sawed-off ends of a broom-handle and shovel-handle respectively, around which the zinc cans were formed."

Early in his relations with the French Company, Burgess began to advocate the establishment of standards for the testing of dry cells. Very little testing had been done by the industry, and it was difficult to make comparisons between different makes of batteries. As a result of Burgess's efforts, the American Electrochemical Society formed a committee on standards for testing, and in due course such standards were promulgated.[84,85] Some years later this work was taken over by the U.S. Bureau of Standards.

Also sponsored by Burgess was the then rather startling proposition that the entire battery industry would benefit if its members would share with the public a good deal of helpful information which had customarily been withheld. He persuaded the French Company to let him publish in its name a series of bulletins giving useful information hitherto supposed to be secret. The nature of these bulletins may be seen from some of their titles:

No. 15 On the construction of dry cells
No. 16 On dry cells for telephone service
No. 17 Amperage as a test for a dry cell
No. 18 Influence of cold weather on dry cells
No. 19 Dry cells as spark producers

As Burgess had foreseen, the policy of sharing scientific knowledge, while it helped competitors, earned rich dividends of respect and prestige for the French Battery & Carbon Co.

When, in the letter to his father, Burgess spoke of putting the business on its feet, he implied that there was still room for improvement. He had done a great deal for the business, but the business had done very little for him. About the end of 1908 he drew up a sort of balance sheet covering his financial relations with the company to date. It showed that while his relations with the company had cost him $6,425, he had received about $1,075 plus $1,000 in worthless stock. Totaling the last two items, he had made the amusing notation "Profit and loss, expense and knowledge, $2,075." The balance sheet was not very formal, but it was eloquent, and it was followed by several lines of comment, including the following:

> Inventory found to be defective, at too high a price and worthless for product.
>
> Could have put in other time at $40 to $50 per day; refused various commissions and offer of position.
>
> Paid more for Hambuechen's time than received; also Hickens, Kowalke, Dickerman and Watts.

As to the twenty shares of stock furnished to Burgess for use in paying his assistants, he disposed of six shares in this way, and then, realizing the "very low and uncertain value" of the stock, began making payments in cash out of his own pocket.

Burgess's first formal contract with the French Battery & Carbon Co., under which he did all of the experimental, engineering and testing work for that company, had been made in the spring of 1908. It was under this arrangement that he employed Hambuechen. Burgess's compensation was to come, in part at least, out of savings in manufacturing costs resulting from his endeavors. A new contract was made in the spring of 1909 under which he was to receive $300 a month and was allowed to work on flashlight cells on his own account. This he did, stating that he was willing to transfer this business to the French Company if that company became interested.

By the summer of 1909 Hambuechen and Burgess were sending out samples of flashlight cells for testing purposes. Some of these went to public utilities in Chicago and Milwaukee for use by meter readers, and some to police departments in Madison and other cities for use by the policemen. Early in 1910 Burgess decided to go into commercial production.

In March 1910 Burgess was in jubilant mood. In a letter to his wife he reported that business was booming, the French Battery Company was preparing to reorganize and expand, the Lorenz Model Company had $3,000 worth of business in hand and more in prospect, "and we are going to double our force." He closed the letter with an item of family interest: The *New York Times* had given a very favorable review to "Charlie's book." Charlie was Mrs. Burgess's novelist brother, Charles Tenney Jackson, and the book was *Day of Souls,* one of his most popular works. The spirit of success was in the air.

Within a few weeks, Burgess was busy preparing for the opening of separate business quarters, in a small machine shop at 625 Williamson Street. Entering his employ was Otto E. Ruhoff, who was to help on battery and other work. For advice about machine-shop equipment, an expert mechanic, Lorenz Maisel, was engaged. The move to 625 Williamson Street was not a day too soon. It helped to relieve a trying situation at the University, where Burgess's personal work had begun to assume—in the minds of some of his critics—disturbing proportions. As explained by a former student, one of Burgess's loyal friends:

> C. F. had all kinds of projects going on in the University laboratories. Dry cells were everywhere; work on zinc was going on. C. F.'s assistants were using various rooms; there seemed to be as many of them as there were instructors.
>
> He simply had to have more room, not available at the University. He was about ready to start manufacturing flashlight cells. Furthermore, he was being criticized severely for his outside activities. He needed some facilities badly for his development work, and particularly the work on the miniature dry cells.

On September 16, 1910, about ten weeks after moving into the new

quarters, and after Burgess had developed a flashlight cell which he believed superior to any then on the market, the Northern Chemical Engineering Laboratories sold their first order of flashlight batteries to the Madison Gas & Electric Co., whose meter readers had been using Eveready batteries. It was eight weeks after this historic sale that the N. C. E. L. was duly incorporated.

At this point in our story several questions might be asked: Why did Burgess begin making dry batteries, and not some other product? Was he not thus competing with the French Battery & Carbon Company, a client? And how did he raise money to finance this new manufacturing venture? Answer to the first question can be given in Burgess's own words: "We began with the dry battery because that was the only thing cheap enough to come within our capital structure." As to the second point, we have already mentioned that the French Battery people were not interested in making small cells; they said to Burgess, in substance, "If you want to make flashlight batteries, go ahead; and if you wish, we'll be glad to sell them for you." This offer was accepted, and for a while it worked out satisfactorily, without any suggestion of competition. The third question, about money needed for promoting the flashlight business, is important; it brings us to one of the many detours in this biographical journey, and calls our attention to a seemingly unrelated subject—the subject of sherardizing.

Sherardizing, named after the English inventor and prominent metallurgist, Sherard Osborn Cowper-Coles, was called by him "a process for rendering iron and steel rustless." Burgess learned about it in 1904, and then described it as follows:

> The articles . . . of iron or other metal . . . are placed in an iron cylinder partially filled with zinc dust, in which they are imbedded. Air is exhausted from the cylinder, and after it is subjected to a temperature several hundred degrees below the melting point of zinc for several hours, the zinc forms a coating upon the surface. It is said that this coating possesses great adherence and durability, as it actually alloys with the underlying metal.

Several years later, because of Burgess's recognized position as an expert in the art of coating iron with zinc, he was asked to carry on some tests of sherardizing, to determine its value in comparison to the competitive hot and cold galvanizing processes in general use. These tests were ordered by a concern which was exploiting the Cowper-Coles sherardizing patents in the United States, the United States Sherardizing Company, of New Castle, Pa., of which F. J. Kirk was president. Burgess's reports on his tests were largely favorable, which naturally pleased his client.[60] A dispute arose, however, when the client advertised Professor Burgess's favorable comments and suppressed some of the unfavorable. Burgess promptly protested the use of his name with such partial testimony which made it misleading. His protest was accompanied by some friendly and constructive advice:

> From a purely business point of view, if not from any other, I do not believe in making or attempting to uphold erroneous

> claims. Sherardizing does not need it. It has distinctive merits of its own.

Referring to some later tests, Burgess wrote in May 1910:

> I propose to submit the results of such work in the form of a report, with the understanding, however, that where such reports are used for publication, such publication will be in form acceptable to me.

Later in 1910 came the transaction which, as we have hinted, promised to bring some much-needed money to Burgess and his associates, and to ease the way for their entry into the business of making flashlight cells. Not content with merely making the tests ordered by his clients, Burgess undertook an intensive study of the process, to see if it could be improved. This research, strictly his own affair, conducted at his own expense, led to a discovery of major importance. He found that he could sherardize with a material much cheaper and more available than the zinc dust covered by the patents under which the United States Sherardizing Co. was operating. This substitute was made from zinc dross, a waste product of the hot-galvanizing process. Soon afterwards, Burgess visited Mr. Kirk, to give him the results of the routine tests which had been ordered.

Mr. Kirk was a rather pompous individual, who respected Burgess's scientific achievements but was inclined to belittle his business ability, and to question the value of independent research by him where the sherardizing process was involved. This was an attitude not calculated to endear him to Burgess. Burgess was not particularly interested in carrying on routine tests, even though they brought some income to his newly established Laboratories. He was willing to make these tests because the sherardizing process seemed to offer real research possibilities; he hoped that the tests would prove the need for a program of comprehensive research, and that the client would eventually ask the Laboratories to engage in such a program. Mr. Kirk was typical of the business men of the era; it was difficult to interest them in research; few of them knew what true research was, and fewer still really believed in it. Then and there, Burgess prepared to demonstrate the value of real research, and to show how it differed from the routine testing and casual experimenting often misnamed research. He decided that the one-man class before him was going to learn about the real thing, with him as instructor; and he felt confident that his pupil would end up by recognizing some research of unquestioned value, and paying for it. He knew the type of individual with whom he was dealing, and was reasonably sure of the outcome. When the results of the tests had been turned over to Kirk and explained, and Burgess was about ready to leave the room, the two men had a conversation which neither of them forgot. It ran about like this:

> . . .Oh, Mr. Kirk, there's another thing I want to mention. As you know, I'm interested in all phases of galvanizing, and I've been doing some independent research on sherardizing. It has

cost me several hundred dollars. I thought perhaps you'd like to buy it. If so, you're very welcome to have it at cost.

Thanks, but we'll have to pass it up. Right now, we can't afford to pay you for any new research.

Burgess took his hat and prepared to leave the office. Then he turned and continued the conversation:

Mr. Kirk, I wonder if you'd be interested in a process that would save you a great deal of money on your sherardizing?

Why, yes, we're always glad to be able to save money. What have you in mind?

I've found out that you can use something much cheaper than zinc dust. I can show you how to get just as good results with galvanizers' dross; it's a process not covered by your patents.

Well, now you're talking. That's just the kind of thing we're always glad to hear.

But that's the very thing I was offering you just now—the thing I discovered in my research.

Oh, well, I'll be glad to pay a few hundred dollars for that.

And I'll be glad to sell; but I'm no longer willing to sell without profit. My price now is Ten Thousand Dollars.

Mr. Kirk demurred vigorously; but eventually it was agreed that if Burgess obtained the necessary patent protection for his dross process he would be paid $5,000 for the United States rights and be allowed to dispose of the foreign rights separately.

Late in 1910 it appeared that the $5,000 would eventually come in, but Burgess unhesitatingly turned the patent applications[107-110] over to the newly incorporated Laboratories at a figure which only covered his out-of-pocket expenses for preparing them. In this way all the stockholders were helped. Burgess's attitude always was that anything which benefited the corporation sooner or later benefited him. It was with the hope and expectation of getting the "Sherardizing $5,000" that Burgess and his friends plunged into the battery business.

On December 2, 1910, only three days after incorporation of the Laboratories, the factory of the French Battery and Carbon Co. was destroyed by fire. This was a severe setback, not only for the French Battery people but for the Burgess group. Burgess's flashlight development work and the prosperity of the Laboratories, would be hindered materially if his substantial consulting fee from the French Company should be cut off. Fortunately this did not happen, and no one seems to have been unduly downhearted, if we may judge from an item which appeared in one of the University publications:

The factory of the French Battery & Carbon Co., located at Madison, of which B. B. Burling '07 is superintendent, was recently destroyed by fire. A new building was leased, and within a week's time new machinery was installed, and the factory put into normal operation. This is a record for which Carl Hambuechen '99 is entitled to credit, as he had supervision of the work.

In all probability this item was written by Burgess, who was always

quick to recognize good work done by Hambuechen, as chemical engineer and organizer.

On December 3rd, 1910, before the embers of the fire were cold, Burgess met with his own board of directors. They decided that he was to continue his relations with the officers of the French Battery & Carbon Company, and that Hambuechen was to have charge of dry battery manufacture for F. B. & C. Co., and of experimental work on flashlight cells for the Burgess group. Otto Ruhoff was to assist Hambuechen, to supervise actual manufacture of the flashlight cells, and to assume "such other duties as may make the flashlight department become profitable as soon as possible." A few days later the directors decided "to proceed with the manufacture of flashlight batteries until 1,000 cells were on hand." Quoting Burgess's own words:

> In this way a start was made and efforts were going well, until we were confounded by the announcement that a remarkable new battery was being put on the market—and designated by the name "tungsten battery," presumably because there was no tungsten in it. Obtaining samples for test we found that this new product was decidedly better than that which we could make. This forced us to increased research effort.

The "Tungsten Battery," probably so misnamed because of the popularity of the new tungsten filaments in electric lamps, was put on the market in 1911 by Conrad Hubert's company, the American Eveready Co.* As pointed out by Burgess, it did not contain any tungsten; but this fact did not prevent its acceptance as the best battery obtainable.

To Burgess this new development came as a severe blow. The new tungsten filament flashlight bulbs had materially boosted the sale of flashlights, and Burgess had counted on a good share of the resultant business in flashlight batteries. And now in the race for quality a competitor had beyond all question passed him. However, he refused to be discouraged, and he refused the temptation to continue pushing sales of the now inferior battery. He set the Laboratories to work on an intensive research program with a view to equaling or bettering the rival product; and by the summer of 1912 his efforts were crowned with success. Once more Burgess's Laboratories had produced a cell superior to the best on the market. This new cell, among its other features, called for the use of artificially produced manganese dioxide as a depolarizer, instead of the natural ores previously used. Furthermore, the Laboratories had to work out a method for making this artificial product. By the end of 1912 the marketing plans were being revived, with the result that 1913 saw a hearty increase in sales. Burgess's Laboratories had no sales force of its own; but this did not matter, as most of the cells were sold to the French Company to round out its line of batteries, and to the American Carbon & Battery Company, of St. Louis, for the same reason.

*It should be noted that in 1914 Messrs. Hubert and Stern sold out their American Eveready Company to the National Carbon Company, thus effectively separating the past from the present. "Eveready" is now a trade-mark distinguishing products of National Carbon Co., Inc.

Just as the outlook seemed brightest, Burgess was almost staggered by another blow. Unaware of the issuance in February 1913 of two patents which deeply affected his interests, he was totally unprepared for a happening, also early in 1913, which seemed like a scene from an oldtime melodrama. One afternoon, when he was busy in his office in Madison, word was brought in that a strange gentleman wanted to see him; the strange gentleman's card showed him to be Samuel Stern, of Berlin, Germany. As soon as Mr. Stern was ushered in, he said, "Professor Burgess, may I see you alone?"* The answer was that this would not be necessary; it would be all right to talk in the presence of an assistant who happened to be there. Whereupon the visitor fired his first gun: "Professor Burgess, we notice you are making a battery, and of course you will have to quit." He went on to say, "In the first place you don't know enough to make a good battery; we have some German chemists working on these batteries, and they are turning out a product far superior to yours." Burgess listened politely, but said little. The visitor continued: "If you don't quit, we will flood your market with batteries so cheap that you will face bankruptcy." Burgess replied that he was willing to take the risk; whereupon Stern opened his briefcase and said, "Look at this; this is a patent to Albrecht Heil,[259] and you are infringing it." Burgess read the patent carefully, and found that it was drawn in such general terms that it would be difficult not to infringe it. One claim referred to "the use of a dark brown hydrate of manganese dioxide"; another to "the use of a deep black hydrate of manganese dioxide." Commenting on this, Burgess said "There has never been a pyrolusite produced anywhere in the world that isn't hydrated to a certain extent, and there isn't any that is not either deep black or dark brown." But Samuel Stern was not concerned with niceties; he said: "We are going to sue you on this patent; we are going to sue you in three different places, and wherever we find the batteries."

By "we" Mr. Stern meant himself, Conrad Hubert, and the American Eveready Company. By "three different places" he meant the French Battery & Carbon Company, of Madison, Wisconsin, the American Carbon & Battery Company, of St. Louis, Missouri, and, presumably, Burgess's own Northern Chemical Engineering Laboratories; all three of these were involved in different ways. The attitude of Stern and Hubert was characteristic of the period. Hubert, a naturalized Russian, joined Stern in adopting the ruthless German methods of crushing competition. In chemical lines the Germans were strongly entrenched in the United States, and they stopped at nothing to destroy the business of an American rival. In his talks during World War I Burgess often discussed this unfair type of economic war, which, it must be admitted, was not a European monopoly.

In the present instance, a number of battery manufacturers were being sued or intimidated; but we are concerned mainly with the suits just mentioned, which affected the "three different places." We have seen how Burgess became interested in one of these "places," the French Battery & Carbon Co., in 1907. Right then, faced with the

*The quoted parts of this conversation are based on notes made by Dr. Burgess.

requirement that he manufacture satisfactory No. 6 cells, he found it difficult to obtain the right quality of carbon. The importance of this ingredient has been explained in the following words:

> Carbon enters battery manufacture in two ways: First as a fine powder mixed with manganese dioxide to form the depolarizing mix; and secondly in the form of a rod which is surrounded by the depolarizing mix to form the positive pole or electrode of the cell.

In 1907 the newly organized French Battery & Carbon Co. obtained its electrode carbons from the National Carbon Co. or imported them from France. As to carbon for the depolarizing mix, the best source for this was the gas works where coal was heated to produce illuminating gas. In 1908 Burgess was seeking new sources of carbon, especially sources not controlled by a competitor, and in that year he was visited in his home by Harold J. Wrape of the American Carbon & Battery Co., of St. Louis. They had met in 1904 at the St. Louis World's Fair, where Wrape had charge of one of the electrical exhibits. Some time after Harold Wrape's visit to Madison, the American Carbon & Battery Co., of which his father, Henry Wrape, was president, began supplying the French Company with battery carbons and also with carbon used in the depolarizing mix of No. 6 cells. Burgess helped both companies, one in its problems of producing satisfactory carbons, the other in its problems of using them.

In addition to producing carbons, the American Carbon & Battery Co. made No. 6 cells; so Burgess was in the position of helping two competing companies; and early in 1913 his Northern Chemical Engineering Laboratories began supplying the St. Louis firm with flashlight cells and batteries. Thus the relationship became three-cornered. Because the three companies served fairly distinct territories, there was little or no friction, and for a number of years Burgess tried to bring about a triple merger. This merger was never realized because the men concerned could not get together on terms, nor, indeed, on business methods.

The flashlight batteries sold by American Carbon & Battery Co. early in 1913 were made by the Laboratories and contained an artificial manganese dioxide developed by the Laboratories. In April the American Eveready Co. warned American Carbon & Battery Co. to stop selling these batteries, on the ground that the use of manganese dioxide infringed certain patents;[259] and, as already stated, Samuel Stern went to Madison to see Burgess and make a similar demand orally.

After much correspondence and several interviews, suits were filed against French Battery & Carbon Co. and American Carbon & Battery Co. Burgess and the Northern Chemical Engineering Laboratories undertook to defend the suits, and assumed much of the risk involved. As stated by Burgess:

> The defensive methods involved an extensive laboratory study and an investigation of scientific, technical and patent literature,

> to demonstrate conclusively to the court that the patents in question belong to that large class of German patents which are sometimes designated "fake patents," that they are illegal, and should therefore be declared invalid, and that even if valid no infringement exists.

When Burgess referred here to "German patents", he had in mind certain patents taken out in the United States by Germans.

It was now necessary for Burgess to start another intensive research program, to produce a battery mixture equalling or excelling the one he had developed in 1912, but without the use of artificial manganese dioxide. This forbidden ingredient was characterized by an almost impalpable degree of fineness. To equal it without duplicating it was a problem. Burgess comments:

> The problem was solved by the discovery or flash of genius by one of the associates that these patents could be avoided and an even better cell made by using not graphite and impalpable manganese dioxide, but ordinary manganese dioxide and impalpable graphite.
>
> This resulted in a patent which had to stand the test of litigations and commercial usage, by both of which tests it was proved to be important among the many hundred patents which harass the dry battery art.

It is true in a sense that the problem was solved by a "flash of genius", but the flash served only as a signal; it showed the path to follow in research. This path led Burgess to Niagara Falls, and to the door of his good friend Edward Goodrich Acheson, famed inventor of artificial graphite. He appealed to Dr. Acheson for assistance, asking him for samples of all the different grades of fine graphite which he had available. Dr. Acheson gladly furnished the samples, which were then used in making experimental cells. From one of the samples amazing results were obtained, much better than Burgess and Hambuechen had expected. And now let Burgess tell what happened next:[86]

> I then called upon Dr. Acheson, seeking to arrange for a supply of this particular grade, telling him what we had found as to its merits. I recall his quizzical smile as he went on to explain that he had tried so fully to comply with our request for all the grades he could send, that when his collected samples were ready for shipment, he had an afterthought.

If Burgess had been a punster, he would have called it Dr. Acheson's *rafterthought,* and he would not have been far wrong; for Acheson had instructed one of his workmen to climb up on the rafters over a furnace room, and brush off the dust which had been collecting there for years. As luck would have it, this was the sample which had broken all records. And there wasn't any more! So, again in the words of Burgess:

> Here, then, was a new problem: To find how to produce this impalpable graphite in quantity. Dr. Acheson and his associates undertook to solve this problem, and, after struggling with it for months, succeeded.

> Thus was laid the basis for a construction which became standard in the manufacture of many million of such cells which have been marketed.

The cost of defending the suits put a severe strain on the finances of Burgess and his associates. Merely preparing for the defense called for an expenditure of $10,000, a considerable sum in those days. In a letter written October 20, 1913, to his old friend Dr. C. S. Carhart, Burgess remarked, "Among our problems is the attempt of the wicked trust to make us quit business." By "trust" Burgess meant the original American Eveready Company and its subsidiaries, which, he said, then controlled over 90% of the nation's business in flashlights and flashlight cases. Later he was able to write:

> The attack did not bring bankruptcy. The enemy chose not to have the case go to court decision, and withdrew from the attack by signing a treaty providing for no annexation.

The reason for this relatively amicable settlement is not hard to guess. By the end of 1913, because of the dramatic discovery of impalpable graphite, there was no longer any need for the Laboratories, the French Battery & Carbon Co., or the American Carbon & Battery Co., to use artificial manganese dioxide, and they were not even remotely infringing the Heil patents. Although, on the theory of an earlier infringement, the American Eveready Co. might possibly have won the suits, it would have been a hollow victory; the defendants could have gone on marketing a flashlight superior to that offered by the Eveready people, and the original purpose of the suits would have failed. So it was that on January 29, 1914, an agreement was made, signed by Conrad Hubert and Samuel Stern for the American Eveready Company, and by Chas. F. Burgess for the Northern Chemical Engineering Laboratories, in which Hubert and Stern agreed to withdraw their two suits, and Burgess agreed that Hubert and Stern were to be licensed to use the "Burgess" mix for their batteries, under specified conditions.

In plain language, the suit was withdrawn because Burgess had shown that he could make a better battery. He used to say "In 1913 they sued us and threatened to put us out of business, and in 1914 they wanted to be licensed under our patents."[117,122] For various reasons the option for licensing was not taken up by Stern and Hubert; but the litigation was ended, and it seemed clear that "the wicked trust" and the independents had decided to call it a day. As we have said, all this controversey occurred while the American Eveready Company was headed by Conrad Hubert. When Mr. Hubert made an outright sale of American Eveready to National Carbon Company, which he did soon afterwards, everything was changed. Burgess and National Carbon could start with a clean slate.

22.

Dry Batteries 1914-1922. Relations with the French Battery Company and Establishment of Burgess Battery Company

FREED for the time from patent infringement suits, Burgess found himself firmly established as a leader in the battery industry. All or most of the independent dry cell manufacturers had been threatened by Stern and Hubert, and several suits had been filed. Burgess's refusal to be cowed by the Eveready threats had heartened the other defendants, with all of whom he had maintained a friendly relationship. He was always willing to discuss their problems with them, and some of them received from him a great deal of valuable help.

In 1914 Burgess and his associates continued to devote much of their time to the battery business. Carl Hambuechen represented them in St. Louis where he had been sent to help the American Carbon & Battery Co. Burgess remained in Madison and maintained his relations with the French Battery & Carbon Co.

In March 1914 Hambuechen decided to separate himself from the Burgess organization, and to stay in St. Louis with the American Carbon & Battery Co. Hambuechen seems to have felt that by working for Burgess he gave up some of his freedom. In his letter of resignation —a letter expressing the warmest personal regard—he remarked "I cannot work . . . blindly for one person and drop my entire personality . . . I regret that in a business way we are not as close to each other as we are friends; and as a friend you will find me to be *with* you." He also said "I have certain ideas along certain lines which are opposite to your ideas." This was probably a reference to ideas as to how the business should be conducted, in which, as Hambuechen said, he and Burgess were sometimes "opposite." Burgess replied promptly:

> It is needless for me to tell you that I have a deep personal regret that this course appears necessary to you, and our laboratories are losing much in parting with your services. I want to assure you with equal sincerity that you will have our friendship and our cooperation in any way which will be to your personal advantage. You certainly have our best wishes for your success.

The actual separation did not come till many months later, and although the two men afterwards disagreed on some questions, their friendship lasted, loyal and undisturbed.

In July 1914, dealers who had been buying flashlight batteries from Northern Chemical Engineering Laboratories were notified that in the future they would have to order them from the French Battery & Carbon Co., and that henceforth the batteries would be known as "French Flashers," and would not bear the "Northern Light" trademark hitherto used. This was provided for in a contract dated May 13, 1914, between the Laboratories and the French Battery & Carbon Company. The Laboratories still made the separate cells; the French Company bought these and assembled them into batteries with appropriate jackets and labels. This arrangement relieved the N.C.E.L. of the burdens of marketing; but it held some disadvantages for both parties. The Laboratories now had only one customer for their product, thus losing direct contact with the buying public; and the French Company, while doubtless glad to sell batteries under the name "French", still had no control over the source of these batteries.

On July 28 Austria-Hungary declared war on Serbia, and started a chain of incidents that shook the world. Destruction in Europe soon called for production in America. On November 10, 1914, Burgess wrote to his father:

> We have a request to furnish over a million batteries for one of the foreign armies, and we are trying to arrange to fill the order during the next 90 days. If we do, we can make $10,000. And this is only one of many like opportunities.

Ten thousand dollars would be an important sum at this time. Amounts like this would help the Laboratories recoup some of the losses and make up for some of the business difficulties which beset them. Profitable war work was offered to Burgess earlier than to American industry in general. It should be made clear, however, that although Burgess was willing to accept profit from the sale of military items to foreign governments, he was not eager to do so in the case of work done for the United States Government when it entered the war. War work and contracts, though cheerfully undertaken, were a source of difficult problems, and Burgess would have avoided them if he reasonably could.

There still was time for other things than war. On March 9, 1915, James B. Ramsay reached his 46th birthday, and was tendered a dinner at the Madison Club, with Burgess as toastmaster. An ambitious program of speeches and stunts was provided, and the room, table, and birthday cake were lit not with candles, but with French Flashers alone. Burgess, who could be very amusing when he "let himself go," gave a topical speech based on Lesson No. 3 of the Sheldon Course in Business Building. Guests at the dinner were from the French Battery & Carbon Co. and the newly-named "C. F. Burgess Laboratories."

Change in the Laboratories' name was followed by other changes, due to the growth of the business in general, and of the flashlight depart-

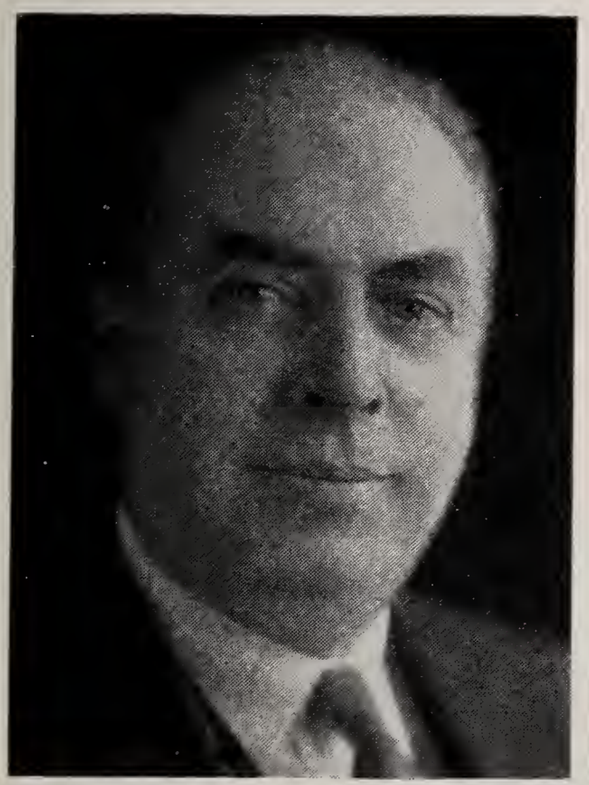
ment in particular. The May 1914 arrangement with the French Battery people was found to be unsatisfactory, because the cells made on Williamson Street had to be carted over to the French plant on Dickinson Street. As the volume of business grew, this inefficiency became more apparent The old contract was therefore canceled, and a new one was made July 19, 1915, under which the manufacture of flashlight cells was moved to the French plant, though still under Laboratories' operation. The new arrangement was on a profit-sharing basis. The affairs of the two companies were becoming still further interlaced.

Tuesday, November 30, 1915, was the fifth anniversary of the incorporation of the C. F. Burgess Laboratories, ample reason for another celebration, which was duly held, and which turned out to be the eve of an important and unwelcome event. As Burgess once explained it, "We celebrated the fifth anniversary of our incorporation, and started in on the next day with a bonfire." On the night of December 1st a fire of unknown origin wiped out the plant of the French Battery & Carbon Co., with considerable loss to the Burgess Laboratories whose flashlight cells were now being made there. Strangely enough, this fire occurred within a few hours of the anniversary of the French Battery Company's fire of 1910. Loss to the Burgess interests was about $35,000, covered by about $20,000 insurance; but the most serious blow was felt in the loss of production at this busiest time of the year.

Early on December 2, 1915, Burgess telephoned Hambuechen in St. Louis, and as a result received an immediate offer of help from the president of the American Carbon & Battery Co., Mr. Henry Wrape, with whom, by the way, he had recently been engaged in hot controversy over some business differences. If Henry Wrape had seemed hotheaded, he now proved that he was equally warm-hearted. He offered the loan of several much-needed machines, and also volunteered to roll "cans" for small flashlight cells and ship them to Madison.

Meanwhile in Madison, Walter B. Schulte and Lorenz Maisel were equal to the emergency; within a few days they had collected "a good machine-shop equipment," and had set it up at the Williamson Street plant of Burgess Laboratories, where all flashlight manufacture would have to be done for the next few months. To make room for the flashlight work, the Burgess office was moved to the unoccupied part of a neighboring store building. No one was left in doubt as to the business of the *other* tenants of that building; their principal stock in trade was advertised by the rich, pungent, and more or less invigorating odor of fertilizer.

Offers of financial aid came to Burgess from his father and from Charles H. Tenney, his wife's kinsman. In both cases he was able to decline with thanks. Thanking his father, he added, "As a matter of fact, this whole thing will probably be a benefit to us at the end, as it will be the means of getting into better permanent quarters." To Mr. Tenney he said, "You know it is a good thing once in a while to let go, spit on your hands, and get a new grip—and we expect to get a better grip through this process." On December 9, 1915, he wrote to Hambuechen:



Duncan Keith

Benjamin S. Reynolds

> We expect to be making flashlight cells at a pretty good rate by the first of next week. . . . The French Battery began the manufacture of No. 6 cells today, using the West Side plant for storage purposes and for making cans, and doing their tamping and packing at the recovery plant.

The recovery plant had been established by Burgess for the purpose of reclaiming and purifying the manganese dioxide in exhausted dry cells. This was done when World War I shut off the supply of manganese dioxide ores from Russia and artificial manganese dioxide from Germany. It was proved that under wartime conditions a plant of this type could be operated at a profit. As early as 1907, when he took charge of the problems of the French Battery & Carbon Co., Burgess had considered the possibility of using materials reclaimed from used dry cells. The Laboratories had done important work in this field in 1912, and Burgess had interested some of his students, who also worked on the problem for several years, and unearthed information which in the national emergency became immensely valuable. Operation of the recovery plant involved a great deal of tedious detail. There were technical problems, of course; but there was also the problem of where to find the old cells, and how to collect them. It is enough to say that all difficulties were overcome, and that the acute manganese ore problem of the French Battery Co. was largely solved by—as Burgess used to say—"our competitors furnishing us with the scarce manganese dioxide." By this means an important service was rendered; and it is interesting to note that no other battery manufacturer then recovered values from dry cells.

On May 25, 1916, in another effort to meet wartime shortages, the Burgess Minerals Co. was incorporated, with a capital of $15,000. Most of the stock was held by the Burgess Laboratories. The purpose of this company was to mine and market manganese ores for all purposes. Describing this venture, Burgess wrote, 25 years later:

> We opened up a mine in Utah, and lost everything except our shirt in doing so. Our work was largely responsible for the discovery of the suitability of the manganese dioxide in the Philipsburg region, and it is from this source that we have been drawing largely for our supplies ever since.

Toward the end of World War I the Philipsburg region of Montana did indeed become the main source of manganese ore for dry cell needs in the United States. It is still the leading domestic source of dry cell ore, but in peacetime the main supply is imported from Africa.

Burgess's strenuous life at the office was relieved of much of its tension by the relative calm that prevailed at home. Home did offer some problems, of course; but they had to be met largely by his good wife, and she, armed with a priceless sense of humor, was ready for all contingencies. One day in 1915 an amusing thing happened at the house on Livingston Street. Playing on the side porch were Betty and Jack, also two children of the Muther family, who lived next door. Mrs. Muther, sitting at one of her windows, could see what they were doing, and what she saw sent her to the telephone, for a brief bit of neighborly dialog:

C. F. Burgess about the time of World War I

C. F. Burgess during the middle 1920's

C. F. Burgess during the latter 1920's

Mrs. M.—Mrs. Burgess, do you know what our children are doing?
Mrs. B.—No, I haven't any idea.
Mrs. M.—They're smoking!
Mrs. B.—What do you want me to do—call the fire department?

Not so easily smiled away were some of Burgess's business difficulties. After the 1915 fire, and partially as a result of that fire, relations with the French Battery & Carbon Co. were becoming strained. Misunderstandings had arisen fairly often, due in part to the complexities of the situation, in which several of the Burgess men were intimately concerned with the operation of the French Battery business. In such a set-up, minor difficulties could easily arise, with questionings as to "What's what?", or "Who's who?".

Burgess saw troubles ahead. As was his custom, he sought to forestall them and to insure peace by separation. He suggested a plan under which the French Company would buy from the Laboratories whatever equipment and machinery it needed for making flashlight cells and reworking exhausted cells, the French Company also to set up its own research and engineering laboratories, and make flashlight cells under a license from C. F. Burgess Laboratories. The financing of such a plan, however, would add to the financial problems of the French Company, which were already acute.

The situation was tense; and the tension increased on February 14, when the French Company's bankers and officials came to Burgess with the request that he have the Laboratories guarantee the bonds of the Battery Building Company, recently formed to finance and erect a new plant. In talks with Ramsay, Burgess had disapproved this proposition, because, as he pointed out, the building was to be on land owned by the French Company, and also because the French Company reserved the right to acquire the building. Half of the building was to be leased to the Laboratories for manufacturing operations, but the Laboratories would have no equity in building or land. Burgess refused to consider the proposition; he said "It would corner me into a financial deal which would be unwise from my company's standpoint."

Two days after Burgess explained why he would not guarantee the building bonds, he was virtually ordered to change his mind. Fred M. Brown, president of the French Company, demanded that the Laboratories immediately sign a lease for half of the new building, regardless of the fact that the terms were unsatisfactory. In Burgess's absence from Madison, his friend and attorney Vroman Mason protested, only to be told that he could take his client and "go down and out." He had already been told by another French Company representative that "he didn't care whether Burgess signed or not." Burgess could put up with a good deal, but this was too much. When he was advised of what had happened, he immediately canceled the consulting and engineering agreement under which the Laboratories had been serving the French Company. This was on February 20, 1916. However, he still maintained that some new kind of relationship could be established with the French Company, perhaps on the basis of a licensing plan. Then, on February

23, without waiting for such a plan to be put into operation, Otto Ruhoff left, to go with the French Battery people and head a new department in which they would make flashlight cells for themselves. Ruhoff's written resignation did not reach the Laboratories until February 24.

Ruhoff's sudden exit added to the pain of an already painful situation, especially when Burgess discovered that Ruhoff, while an official of the Laboratories, had been serving Ramsay secretly for about a week prior to February 24. The importance of this discovery was recognized in a legal decision several years later, when the judge wrote:

> Beginning on the very day of the breach between the French Company and the Laboratories, when Mr. Mason was told to take his client and go down and out, Mr. Ruhoff began putting in full time at the French Company . . .

Then Burgess learned that Ruhoff had been to St. Louis, seeking aid from the American Carbon & Battery Co., then a licensee of the Laboratories, to start the French Company in the manufacture of flashlight cells, This also was mentioned in the legal decision referred to:

> Mr. Ruhoff sought to conceal the fact that he had gone to St. Louis to get help for the French Company from a licensee of the Laboratories, who was bound by a contract, executed by Mr. Ruhoff as an officer of the Laboratories, not to give assistance to the French Company. Mr. Ramsay told Mr. Burgess that he did not know where Mr. Ruhoff was, when the fact was that he knew Mr. Ruhoff had gone to St. Louis at the request of Mr. Ramsay, and that the expenses of his trip were paid by a French Company check signed by Mr. Ramsay.

While Ruhoff was in St. Louis he had visited Carl Hambuechen, to enlist his aid; but Hambuechen, although no longer working for Burgess, was loyal to him, and refused to take part in an arrangement which, he protested, was unfair. Henry Wrape, President of the American Carbon & Battery Co., took a similar stand; neither his contract with the Laboratories nor his conscience would permit him to give any information or assistance to the French Company.

Relations between the two companies could plainly never be the same again. Some of the French Company's men were talking and acting as if they expected soon to be able to "ditch" Burgess altogether. But he was not prepared to make a total break. He had virtually created the French Battery business, and, in spite of injured feelings and lost friendships, he was willing to help keep the business prospering. But it would have to be on a strictly impersonal basis.

On March 20, 1916, the Laboratories granted the French Company a license under patents to manufacture flashlight cells, and sold that company the machinery and equipment needed for such manufacture. These arrangements might have served as a means for rekindling at least a spark of friendly feeling, but they did not. The French Company refused to pay for the machinery and equipment, and the Laboratories were able to collect only after taking the matter into court; and when the French Company hired a further number of the Laboratories' key employees, personal bitterness between Burgess and Ramsay began to take on the

aspects of a feud. What happened next is well told in the words of a contemporary:

> When C. F. began to realize that the French Company was intent on a knock-down-drag-out fight, he promply accepted the challenge and acted quickly. He decided to go into the battery business in competition with the French Company, though the odds were heavy against him.
>
> The French Company was in an advantageous position. It had an established business in dry batteries, sales force, dealers, and trade acceptance. It was the outlet for the cells made by the Laboratories, and it now was in a position to make cells and no longer dependent on the Laboratories for them.
>
> On the other hand, the Laboratories had no sales force. It was unknown to the trade, it did not have any equipment to make standard cells. It had to start from scratch, except for the manufacture of flashlight cells and the producion of recovered mix.
>
> But C. F. did not hesitate. The quicker he acted, the less difficult it would be to build a battery business and the quicker he would cash in on the knowledge of the battery business he had accumulated over the years. He did have the advantage, in owning his own business, that he could operate it according to his own ideas.

And so, in March 1917, the Burgess Battery Company was formed, to take over the dry battery business built up by the Laboratories during the previous ten months. We have mentioned that an earlier Burgess Battery Company, planned but not established in 1914, was to have manufactured flashlight cells only. This limitation did not apply to the new company; the Burgess line had meantime been expanded to include standard cells.

Seeking an executive for the new company, Burgess remembered his Alma Mater, and brought Benjamin S. Reynolds '09 from the Chain-Belt Company of Milwaukee, "To engage in the management of the Burgess Battery Co."

The first meeting of the subscribers to the stock of the newly-formed Burgess Battery Company was held on the morning of March 3, 1917, at the temporary offices of the Laboratories, at 730 Williamson Street. First subscribers to the stock were C. F. Burgess Laboratories, 1,000 shares, C. F. Burgess 10 shares, Benjamin S. Reynolds 100 shares, W. B. Schulte 10 shares, Vroman Mason 1 share, O. W. Storey 1 share, R. C. O'Malley 1 share; total 1,124 shares. Duncan Keith was not at the meeting. Elected as directors were C. F. Burgess, Benjamin S. Reynolds, Duncan Keith, W. B. Schulte and Vroman Mason.

Anna Heckman Burgess, widowed for about a year, continued to be interested in every step of her son's progress. Visiting Madison in 1917, she received her first direct impressions of the Battery Company's plant and personnel. Charles went to the station to meet her, and when he brought her right up to the building, his associates were waiting outside, an informal reception committee. "What do you think of them?" he asked. "They're a fine body of men," said his mother. Then she added, "But what I'm thinking about is—how can you *pay* them?" She said it with a smile that left no doubt.

Under an arrangement which has been described as "peculiarly

Burgessian," the Battery Company had no laboratory and did no experimental and development work on dry batteries; but—and this *but* is important—such work was done for it by C. F. Burgess Laboratories. The Laboratories also did all of the engineering work, including the testing. Technically the Battery Company was a client of the Laboratories, just as the French Company had been prior to 1916.

In 1917, when the infant U. S. Air Force was working on the problem of getting satisfactory communication between airplanes and ground, the crying need was for a light-weight, high-voltage battery of rugged construction, occupying a minimum of space. A further requirement was that individual cells be thoroughly insulated from each other, to minimize the possibility of current leakage developing between cells during use. Officials in Washington, who for a year or more had been aware of the achievements of the Laboratories, now turned for help to the Burgess Battery Company. Burgess entrusted this emergency assignment to W. B. Schulte, who designed the historic first "B" Battery, [263] incorporating a novel construction which met the rigid requirements. Thankfully adopted by the Air Force, this battery became a standard to be met throughout the industry. Some early B-Battery enthusiasts were *sure* that the B stood for Burgess! It is true at any rate that in designing this battery, the Burgess Battery Company marked an important milestone in the history of dry battery manufacture.

During its first ten months of operation, the Battery Company's sales amounted to over $145,000. By October 1917 $30,000 worth of dry batteries a month were being sold, and before the end of the company's first year it was able to pay a 3% dividend. By July 1918 stockholders of the Laboratories were told that the Burgess Battery Co. was bringing them "an income in the form of dividends at the rate of $500 per month. The earnings of this company are beyond this amount, and probably represent a materially greater income for our laboratories than the dividends indicate." In October 1918, when "Pat" O'Neil offered to invest $13,000, Burgess was able to say "I may be glad to call on you later, but we don't need it just now."

An important improvement in battery construction is mentioned in a letter written by Burgess on October 6, 1917, in which he said:

> A development which I believe is coming in the battery field is the use of drawn, seamless cans, and we have been successful in working out methods of making these.

For a number of years Burgess had been experimenting with methods for making zinc flashlight cans, first by the electroplating process and later by drawing the zinc. It was through Burgess's encouragement and optimism that a Battery Company employee, Lorenz Maisel, finally worked out a means for drawing the seamless cans.[264] By 1918 the Burgess Battery Co. was beginning to use drawn zinc cans in place of the old soldered cans wherever it was possible to do so.

Burgess believed that no profits should be made on war orders from the United States Government, and he found that in carrying out this belief there lay a risk of suffering actual losses. After the Armistice,

November 11, 1918, many government orders were canceled, and the Burgess Battery Co. was left "holding the bag," particularly where it had started working on emergency orders. These orders had been telephoned from Washington, with the understanding that written contracts were to follow as usual. Some of the later orders were not confirmed in writing, and the Battery Company, which had gone ahead in good faith, was informed that it had gone ahead without authority. Burgess could not forget such policies, and his attitude towards other government activities became, to put it mildly, unfavorable.

Another experience following the Armistice was altogether different. One pleasant morning in 1919 Burgess was visited by a friendly young man from Connecticut, who introduced himself as Edwin Pugsley, Chief Engineer of the Winchester Repeating Arms Co. Suppose we let the friendly young man describe what happened, as he remembered it nearly thirty years later:

> I was shown into Dr. Burgess's office promptly, and told him who I was, that my company had decided to go into the battery business, and that I was out there to ask him whether he would consider helping to put us into the business and allowing us to operate under his patents.

Mr. Pugsley gave the reason for this sudden interest of his concern in manufacturing an entirely new type of product. At the time of the Armistice the company's owners had found themselves saddled with an enormously expanded plant and no prospects of enough business to fill it. They therefore cast about for new products, so that, in Mr. Pugsley's words, "we might literally beat our swords into plowshares." One of the items decided upon was a line of batteries and flashlights. And why had they turned for help to the Burgess Battery Company? Again the answer was simple. They had been advised to do so by one of their young scientists, an electrical engineer from Johns Hopkins named William B. Kouwenhoven. During the war Dr. Kouwenhoven had spent some time at the Bureau of Standards, testing batteries for the U. S. Signal Corps, and, continuing Mr. Pugsley's story:

> He told me that beyond question the best batteries for Signal Corps work had been made by the Burgess Battery Company. He further told me that he understood Dr. Burgess was a scientist who had attacked the battery problem from the technical standpoint, and that the Burgess Company was the only one in the business at the time having a battery laboratory.

As Pugsley told his story, he kept wondering what Burgess's reaction would be. He did not have long to wait:

> Dr. Burgess smiled at my youthful enthusiasm and asked me if we knew anything about the battery business. I told him that we knew absolutely nothing about it.
>
> He then countered with the question whether I might possibly like to look at the process, and said I could decide whether we were still interested after I had inspected the factory.
>
> He spent the day with me, and when we returned to his office

> in the late afternoon I told him that we were even more interested in the battery business than before, and asked how he felt about it.
>
> He agreed immediately to consider the proposition, and to meet with my principals in New York shortly thereafter to settle the details.

So began a friendship, between men and between organizations, that flourished undisturbed through many years. Affecting the arrangement were countless problems, some competitive, some cooperative, but all of them resolved in harmony. Burgess went into the plan knowing it involved the building up of an important competitor; but he welcomed competition that was fair. As one of his friends recently remarked, "The Winchester Company's ethics were of the highest order, and this was important to C.F." Mr. Pugsley is now a leading executive of the Winchester Repeating Arms Co., and Dr. Kouwenhoven is head of the Electrical Department of Johns Hopkins University.

No one rejoiced in Burgess's growing prosperity more than his mother. She was still receiving good news about him when, after three years of widowhood, she died. This was on May 25, 1919, when she was 73 and her eldest son was 46. Later on, as the result of a strange mistake, Burgess's own decease was recorded as having taken place in 1919. On the last day of that year, death came to a Texas congressman named George Farmer Burgess, probably no kinsman. Someone, somewhere, noted down the name and date, "G. F. Burgess, Dec. 31, 1919." This entry got changed to "C. F. Burgess," and found its way into Volume 11 of *Who's Who in America,* where it neatly closed a condensed biography of Charles Frederick Burgess, electrochemical engineer. Burgess objected to being officially dead, and asked for a correction, which was duly made in Volume 12. Because *Who's Who in America* deservedly enjoys a high reputation for accuracy, its data are often "lifted" by other publications. Some of these copied the mistake and missed the correction; thus the report of Burgess's 1919 demise was kept afloat for several years.

On December 6, 1919, Burgess became a member of Masonic Lodge No. 5, Free and Accepted Masons, Madison, Wisconsin. He followed through with his Masonic work and received the first ten degrees, becoming a Knight Templar in Robert McCoy Commandery No. 3, and maintaining membership throughout his life. He undoubtedly was influenced in becoming a Mason, as were his two brothers, by the fact that their father had been very active in Masonic work throughout his life, and had urged his sons to become members when the occasion arose, saying to them that "Masonry is not a religion, but it is deeply religious."

Burgess Batteries became international in 1919, when the first Canadian branch plant was established. Burgess Batteries, Ltd., was formed late in the summer, and operations were started in Winnipeg. The purpose of the branch was mainly to protect some Canadian patents which had been taken out covering battery developments.

In 1919 the Battery Company had outgrown the quarters it was leasing in the Laboratories' building, and was obliged to rent adjoining

space. A new building was started in the fall, at Main and Brearly Streets, and was finished in 1920. A heavy strain was put on the finances of the company by high post-war building costs and by a general financial crash which occurred in the United States in 1920 and reached its depth in the summer of 1921. In 1921 the Battery Company was short of money, as was its parent, the Laboratories. "Pat" O'Neil, now given an opportunity to invest the $13,000 he had proffered in 1918, explained that he had tied it up in Texas Gulf Sulphur stock, and that Burgess would therefore have to get along without it. Burgess did. In September 1921, Pat O'Neil wrote inquiring how sales of Burgess Battery Company stock were progressing, and Burgess promptly replied that "one out of every two people that we have approached have become subscribers." Then he went on to say "The only two people that have been approached, however, are George O'Neil and George Burgess."

The stringency was not of long duration. Before many months passed, the radio business began to boom, and the demand for radio batteries began to grow. It grew quickly and continually, for over six years. Through those six years the orders for Burgess Batteries came in faster than they could be filled.

In 1920 relations with the French Battery & Carbon Co., strained for several years, were steadily worsening. A number of provocative incidents, some of them involving allegedly misappropriated patents, had occurred, and Burgess was convinced that the Battery Co. could obtain relief only by applying to the courts. He was specially upset by the seeming disloyalty of some of his employees. One of these was Lorenz Maisel, who quit the Battery Company and made some sort of arrangement with the French Company. Early in June 1921, Burgess called a meeting of all his engineers, chemists, foremen and other key employees. As one of them remembers it:

> He was very grave, and told them in no uncertain terms that he required their unquestioned loyalty, and that if they had any doubt as to their feelings they were to resign.
>
> He then asked them to sign a form of contract in which they recognized the right of the Burgess Companies to their inventions made while in the employ of the Companies, also the confidential nature of their employment and the necessity for secrecy.
>
> Except for one (or possibly two) employees everybody signed. C. F. had suspected the loyalty of one or two of the employees, and this provided the necessary test. The employee (possibly two) who refused to sign, necessarily had to leave the employ of the Company, and later it developed that he had been dickering with the French Company.

On June 18, 1921, the C. F. Burgess Laboratories and the Burgess Battery Company brought suit in the Dane County Circuit Court in Madison against the French Battery & Carbon Company, James B. Ramsay, and Otto E. Ruhoff. This drastic action was not a mere outgrowth of earlier misunderstandings and irritations. It involved definite charges, particularly:

> That the defendants . . . entered into a conspiracy to wrongfully procure the inventions and trade secrets of the Laboratories

> and to appropriate them to the use and benefit of the French Company; that pursuant to such conspiracy they procured certain patents . . . to be issued upon inventions belonging to the Laboratories, and had them assigned to the French Company; that the French Company was not a bona fide purchaser of these patents so assigned, but took them with full knowledge of the rights of the Laboratories in and to the inventions covered by such patents.

Many, if not most, of the leading figures in the case were Wisconsin graduates. The circuit court judge was E. Ray Stevens '93; the Burgess companies were represented by Arba B. Marvin '00 and H. H. Thomas '98; the defendants by E. J. B. Schubring '01 and John H. Lee. The personnel of the plaintiff and defendant corporations, as might be expected, was also largely made up of Wisconsin alumni. The contest, which started in the summer of 1921, was long and bitter; the preliminary hearings were intermittent in nature and lasted well over a year; depositions were taken in various parts of the United States. The final trial started early in September of 1922, and the court was then in continuous session until near the middle of December. About 11,000 pages of testimony were recorded in the final trial, and there were over 2,000 exhibits. The grand total, including papers involved in the preliminary hearings, was over 6,000 exhibits and over 20,000 pages of testimony. During the trial the record of the case was hauled around in a taxicab. Final oral arguments were not held till the summer of 1923, and then each party submitted briefs consisting of several thousand typed pages. Many of the participants were simply worn out. One of the attorneys in the case illustrates this point with a story:

> During the trial, half a dozen of the principals were in the hospital at some stage. I went into a doctor's office in Madison, and as I went in the judge came out.
>
> I said to the doctor, "I am not really sick; I am working too hard on this battery case, and I have only a few hours each night to sleep. I find difficulty in getting off to sleep. Can you give me some non-habit-forming sleeping potion?
>
> The doctor replied, "I will give you exactly what I gave the judge, who was just here for the same purpose."

When the trial was over, two court reporters went to a rest home in Milwaukee for ten days, to catch up on their sleep. Burgess was very tired; he had been on the witness stand for weeks at a time; this during a period when his fullest energies were needed for post-war business development.

The outcome was victory for the Burgess forces. The judge's decision, already mentioned, made this clear, as may be seen from two brief excerpts:

> Mr. Ramsay and Mr. Ruhoff had conspired to wrongfully obtain for the French Company the use of flashlight patents and processes that belonged to the Laboratories.

> Mr. Ramsay and Mr. Ruhoff deliberately mis-stated essential facts as to the means they were taking to accomplish their purpose. When men resort to such practices it is persuasive evidence that they are not using lawful means to accomplish lawful purposes.

The defendants were found guilty and ordered to pay the court costs amounting to about $10,000, eight patents were assigned to the Burgess interests, and damages were awarded amounting to over $48,000. More than twice this amount, however, had been spent by the plaintiffs on attorneys' fees and other expenses; and Burgess wrote to one of his friends that "a few victories of this sort might well put us out of business." The Burgess Companies would have received a much larger amount of damages except for one important point, involving a contract with the French Company in the form of a letter written by Burgess July 1, 1910. Judge Stevens's interpretation of that document differed materially from the interpretation Burgess had intended; and Burgess learned the importance of having a good lawyer review all contracts before signing them.

The French Battery & Carbon Co. filed a counterclaim, which was dismissed by Judge Stevens. Both sides were given ample time to appeal, but no appeals were made. Both sides had had enough.

Burgess had surely had enough. As we have said, he had gone through a very trying and tiring experience. For months at a time he had seldom reached home till late in the evening, often not until midnight; and when he did get there, he had come to a house where the doorbell would not ring, because he could not remember to bring home a battery. After this had gone on for weeks, his wife decided to relieve him of such a petty responsibility; she telephoned an electrician to come and fix the bell. Now let his daughter Betty tell the rest:

> That evening, when Dad returned, Mother announced, "Charles, the bell works. I've had an electrician mend it today."
>
> Dad gave her a look, and went down to the basement to see what had been done. In a minute he was back, and I will never forget the look of fury on his face.
>
> "Ida, what right have you to allow a man to come into my house and put a *French Battery* in my doorbell!"

Tradition has it that he tore out the offending battery, and doomed the bell to another long period of silence. Perhaps a case of justifiable belligerence. Belligerence *is* sometimes justified. Burgess's fighting spirit throughout the French Company suit was duly noted by friend and foe. He realized this, and said that after the suit, others would hesitate a long time before treading on his toes. Without being a member of the Scottish Order of the Thistle, he had earned the right to use its motto, *Nemo me impune lacessit*—No one injures me with impunity. The brave reputation thus established was to help ever afterwards in guarding the rights and property of the Burgess companies.

Encouragement could be gained from the fact that the demand for radio batteries was increasing steadily. Late in the course of the litigation, Burgess wrote to a friendly battery manufacturer, Mr. Thomas W. Byrne, of Boston:

> In spite of the attention which we have to give to this matter, we are greatly gratified to see that the battery business is growing, and that the prospects in this line look particularly good.

January 7, 1922, when the Battery Company was less than five years old, Burgess wrote with pride to his brother George, "Westinghouse seeks exclusive agency on Burgess wireless batteries." Such recognition from one of the giants of the electrical industry was indeed a compliment. Another letter on the same day to Mrs. George H. Burgess discussed the growing importance of radio, and added:

> We are playing an important part in this development by making batteries which have been accepted by both army and navy for their use, and the large companies have standardized on this.

As early as May 1922, Burgess wrote to Harold J. Wrape in St. Louis:

> We are having exceptional success with our radio batteries, and in fact this is occupying our full attention. Some months ago we designed and began to manufacture a crystal detector set which retailed at $40.00 and cost between $15 and $20 to make.

He went on to say that he thought that this crystal set, the Burgess Radio-Ceiver, was as good as any on the market. In this connection it is interesting to remember that A. Atwater Kent also started making radios in 1922. But in his letter to Harold Wrape, Burgess explained that the Radio-Ceiver had been discontinued, "as we did not care to antagonize the people for whom we are making the B Batteries. In other words, the manufacture of complete sets is not our legitimate business." If it had not been for this decision, there might have been a Burgess Radio Company. The decision was doubtless a wise one, as it cleared the way for concentrated and continued research on dry batteries. By the end of 1922 it was possible to report real progress:

> The Burgess Battery Company as an individual company has been in existence only since 1917. . . . The production under the Burgess label has steadily gained in area of distribution from a meagre column of sales in the neighboring states, to a point where they reach practically every state in the Union, and some foreign countries.
>
> The increase in the areas of distribution during 1922 has been greater than in any previous year, and Madison travelers—whether in New York, New Orleans, or Los Angeles—may observe the familiar black and white striped battery in the dealers' display windows.

The report went on to say that the company now employed over 300 persons in Madison alone, besides numerous others in Chicago, Kansas City, St. Paul, New York and Boston; and in a branch manufacturing plant at Winnipeg, Canada.

Safety First was the keynote of a quarter-page advertisement in a Madison newspaper of October 8, 1922, in which the Burgess Battery

Company reminded the public that the annual fire loss in the United States *due to matches alone* was estimated at Six Million Dollars. Then came the reassuring statement that "Burgess Flashlights CANNOT start a fire." This was followed by some good advice: "Don't use matches in the dark corners—play safe and at the same time have a real light."

In a report dated December 21, 1922, entitled "Outlook for Dry Batteries," Burgess called attention to a device using small dry cells for sterilizing water. This had been proposed by him in 1913, and described as an electrochemical sterilizer for the use of explorers and others. It was covered by a patent issued October 3, 1916.[121] Operated with the aid of a flashlight battery, it was later used successfully in hospitals. As recently as World War II another, and presumably larger device using flashlight cells was hailed as a novelty; flashlight batteries used in sterilizing water for the Burma Road were said to be capable of treating 36,000 gallons a day. In Burgess's device, which was used for purifying very small quantities of water, the electric current of the battery was used to generate chlorine from salt in the water, and the invention consisted in the design of an apparatus for generating the chlorine without adding an amount of salt which would make the water unpalatable.

Mention of the "familiar black and white striped battery" in the 1922 report recalls a little human-interest story about the now famous label and trademark, which was one of the assets turned over by the Laboratories to the Battery Company in 1917. It seems that the Burgess colors were not always black and white; for a short time, before the Burgess Battery Company was formed, an experiment was made with blue and yellow, if not for the batteries themselves, at least for a display background. The background of blue and yellow plush did not photograph well, and, according to Walter B. Schulte, who was keenly interested, "A trademark ought to photograph well." Advertisers please note. Mr. Schulte had noted that the Harley-Davidson people, famed for their motor-cycles, painted their name in red on the grey bicycle frames. "The red letters always photographed black, and thus advertised the maker's name whenever the cycle was shown in newspapers." One Sunday afternoon in the fall of 1916, Walter Schulte was sitting with Mr. and Mrs. Burgess on the porch of their home at 416 N. Livingston Street, Madison. They discussed the question of designing a label for the batteries. Walter Schulte said, "I think it ought to be red and black and white, because those colors photograph well." Mrs. Burgess nodded. "Black and white stripes are very popular." Then she went into the house, and came out with a candy box decorated with black and white stripes. (Some authorities say it was a hat box; there's no good story without a few variations). "Fine," said Walter Schulte, "Now let's make a red medallion to go with that." Just at this moment someone passed the house, wearing a black and white striped dress, which was taken to be another vote in favor of stripes. The "red medallion" became a shield-like device. Duncan Keith had a hand in this; he offered a prize for a design to some young people in a Chicago art school. The winner was a deaf-mute. Such is the story of how Burgess Batteries, as their sponsor once jocularly remarked, became "striped for action."

23.

Burgess Battery Company 1923-1926

IN January 1923, one of many attempts was made to induce Burgess to take up the manufacture of storage batteries. J. H. Naiden, of Des Moines, Iowa, brought the question up, and on January 17 Burgess replied, stating in part:

> A long time ago, while having charge of the Electrochemistry and Chemical Engineering Department at the University of Wisconsin, I did a great deal of work on storage batteries, as well as on primary batteries, and I finally settled down on the work of developing dry cells. This field seems to be enlarging rapidly, and while I have been tempted many times to take up storage battery work in addition, we shall probably never get around to actually doing it.

As early as 1901, Burgess had written an article on storage batteries for the *Wisconsin Engineer*.[80] His electrochemistry students at that time learned how to make such batteries. In 1902 he was approached by some Madisonians who were interested in financing a system of electric motor buses or trackless trolleys, based on an English invention. In business districts and over bridges there were to be no trolleys, and the buses then were to get their power from storage batteries. Burgess analyzed the plan, and reported that it would not be economical. In 1911 he gave one of his reasons for not becoming a storage battery manufacturer; in a letter to his former student, J. G. Zimmerman '04, he said:

> Storage battery problems have never appealed to me because of the tremendous amount of work which has already been done in that line, and the great amount of ingenuity exercised. I have no doubt that if you get into competition with Mr. Edison you are going to have much trouble, as Edison has the reputation of very thoroughly thrashing over the experimental ground from every point of view.

Many similar letters were written through the years, all indicating that while Burgess recognized the importance of storage batteries, he deemed it wise to concentrate his efforts on improving the dry cell with the striped trademark.

In March 1923, when their famous trademark was about six years old, Burgess batteries gained a second foothold north of the Canadian

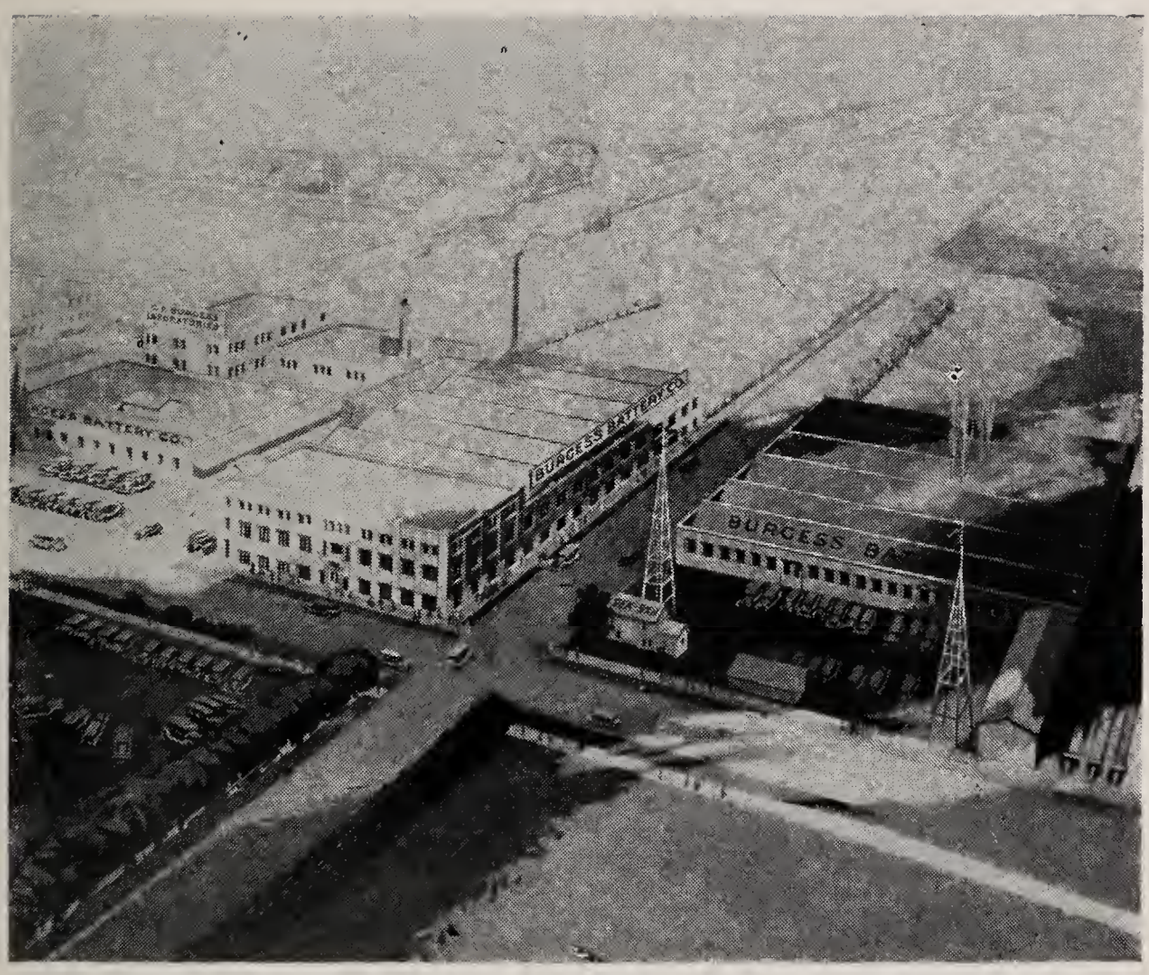
border. This time it was at Niagara Falls, Ontario. A building formerly occupied by Kinzinger-Bruce, Ltd., was bought, and promptly put in shape, according to a local paper, "for the manufacture of the Burgess radio batteries so popular among radio amateurs." By May, production was under way, and soon other dry-cell batteries, for flashlights, ignition and telephone service were being made. The opening of this plant was another reflection of business advances being made at home. On December 28, 1923, Burgess wrote to "Pat" O'Neil:

> We have been having a most phenomenal success with our radio batteries, being fortunate in getting into a very lively field and with a product which is exceptionally meritorious. We have the backing of the leading radio experts of the country, including the government; and this brings about a condition where we could sell four times as much as we can make under our present conditions.

Meanwhile, in New York, history was being made in the motion-picture field. Something new had been added; the silent film had found itself a voice. Talking pictures of a kind had been seen and heard for many years, some of them as early as the turn of the century; but the sound, produced by phonograph records, had often run ahead or lagged behind. Dependable synchronization had been impossible, until Lee de Forest, photographing the voice right on to the film with the picture, joined sound and symbol never more to part. De Forest's invention, the *Phonofilm,* first shown publicly in 1923, was not exactly welcomed by the critics. Quipped James R. Quirk, "Talking pictures are perfected, says Lee de Forest, the inventor . . . . So is castor oil." Karl Kitchen wrote, "The action and the sound synchronize perfectly—but what of it?" An answer to this challenging question came from Hugo Riesenfeld, of New York. Mr. Riesenfeld, able musician, conductor and theatre manager, testified that he had run de Forest's talking pictures for three successive weeks at the Rivoli Theatre; and added, "That my confidence was not misplaced is evidenced by the comments of approval from our patrons. The pictures have attracted great attention. They have a great future." A little later on, Dr. de Forest himself said, "In all our reproducing amplifiers we are using Burgess dry batteries."

In 1924, R. Max Eaton, of the Niagara Searchlight Co., Niagara Falls, N. Y., announced that his company contemplated entering the battery business, and asked Burgess what his reaction would be toward such new competition. This was an interesting question, in view of the fact that Burgess Battery Company had been supplying the cells sold under the label of Niagara Searchlight Company, and had also been buying flashlight cases from that concern. Burgess's reaction was friendly. In a letter dated March 15, 1924, he said in part:

> I can tell you frankly that I believe the "B" battery is here to stay, at least for some considerable time, and that there is going to be a lot of "B" battery business.
>
> You may be assured that if you embark on battery manufacture, you will not arouse any hostilities on our part, or



Burgess Battery Company plant in Madison, Wisconsin, with Burgess short-wave radio station 9EK-9XH in foreground and C. F. Burgess Laboratories in background

> influence us in our desire to handle your flashlight case products.
>
> Should you take up the manufacture of "B" batteries, it would not be good business to refrain from manufacturing flashlight batteries, because the manufacture of both products is so similar.

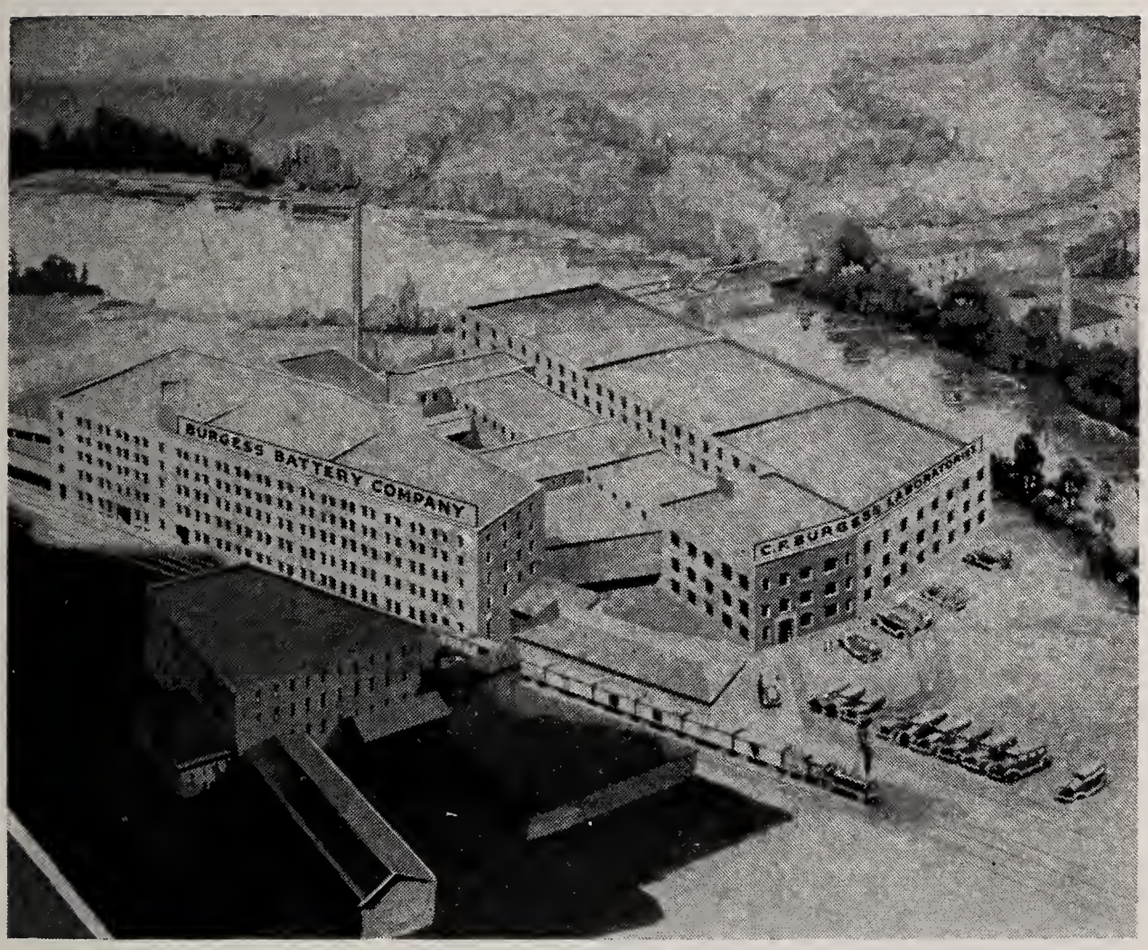
Three years earlier, he had not been so confident about the importance of B batteries. On May 31, 1921, he had written to Major Carl Kinsley, of Washington, D. C., that "We have devoted a great deal of work to B batteries, but have been disappointed in the volume of business which appears to be available in this field." Soon after this earlier letter was written the B Battery boom was well on the way.

Widening demand for the products bearing his name encouraged Burgess to consider seriously the realization of an old ambition. Early in 1924 he began to talk about buying a tropical island off the west coast of Florida, where he might build a winter home and enjoy some new adventures in research. In March he visited Florida for a vacation which he called "the first outing I have been able to plan during the past twenty years." The outing would also enable him to get a look at the isle of his dreams.

Early in April Burgess was back at his desk in Madison, preparing for an eastern trip; for on April 12 he was to visit the U. S. Naval Academy at Annapolis, where he had been invited to address "the officers under postgraduate instruction." His topic, "The Dry Battery," was one of growing interest in navy circles. The importance of the event may be judged from the fact that Burgess was one of five leading scientists invited for such talks in 1924. His audience was to be composed of naval officers with from four to five years experience and responsibility in active service at sea, many of them well qualified in various fields of engineering. As Burgess read his invitation, which came from Commander A. M. Penn, head of the postgraduate school, he was doubtless interested and pleased by such paragraphs as these:

> Most of the officers that will make up your audience are very well acquainted with the storage battery and with the ordinary wet battery, but the information available on the dry battery for instruction purposes is very limited. There is no doubt its field of usefulness is of growing importance. We are therefore looking forward with pleasure to the information on the subject that you will bring us.
>
> The primary mission of our weekly series of lectures, given on Saturdays, is to take the students away from their daily grind on details and fundamentals, but at the same time to give them an incentive to continue by broadening their vision and stimulating their imagination, and by bringing them in contact with men who stand out as recognized authorities in their respective fields of activity.

These paragraphs, especially the second, might have been written by Burgess himself. He went to Annapolis, gave a talk both informational and inspiring, and was himself inspired by an enthusiastic and appreciative audience.



Plants of Burgess Battery Company and C. F. Burgess Laboratories, Inc., and Burgess Cellulose Company in Freeport, Illinois

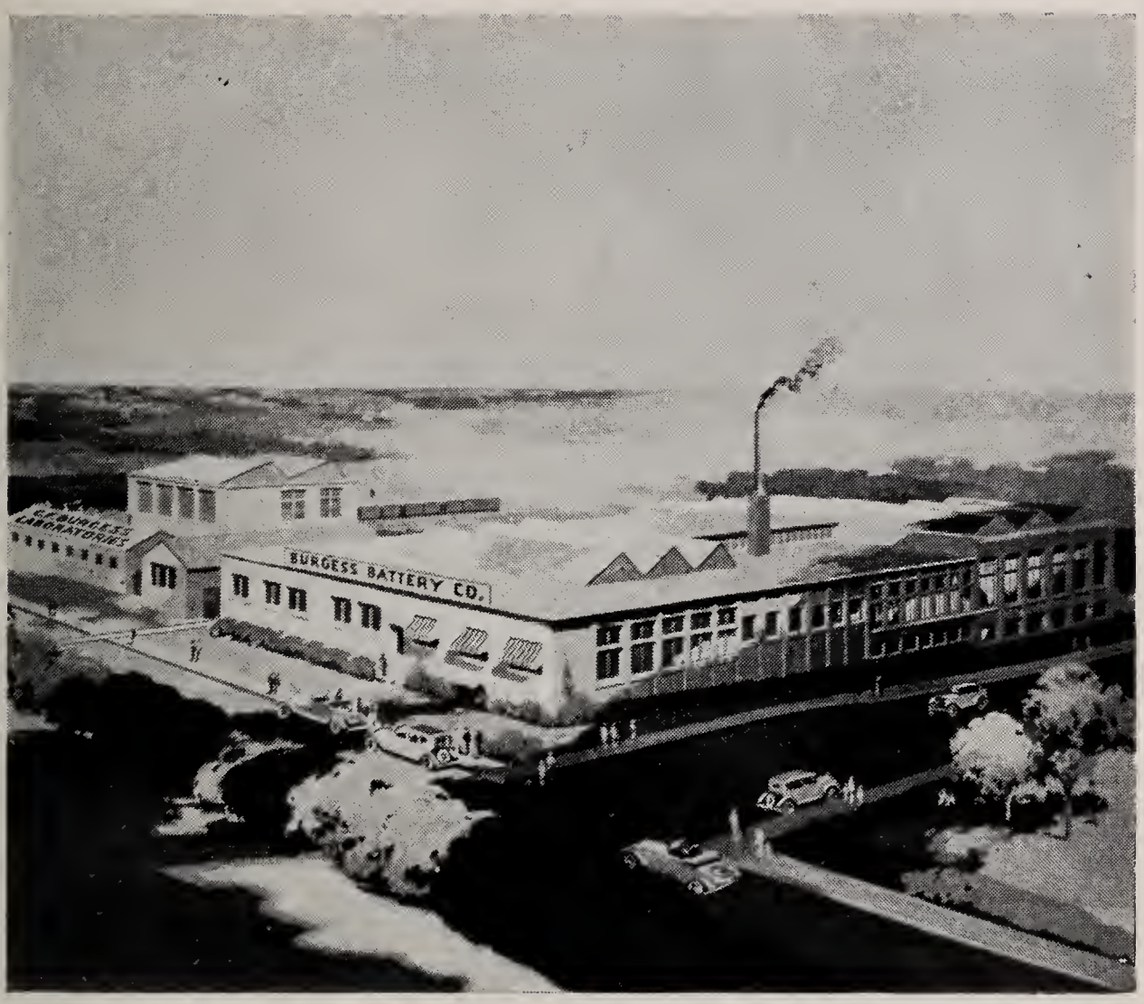
Burgess's talk to the Annapolis men was one kind of national service; later in the year opportunity offered for another kind. Secretary of the Treasury A. W. Mellon announced that thirty million silver dollars had disappeared from circulation, and that the resulting demand for additional paper money was a serious drain on the Treasury. According to a story in the *Capital Times* of December 22, 1924, if the thirty million silver "cartwheels" could be restored to circulation, it would save the nation $828,000 a year. One gets the impression that in 1924 this amount was worth worrying about; people had not yet begun thinking in terms of billions. Whether or not the Mellon appeal was important, most business men promptly forgot it. But not Charles F. Burgess. His reaction was, "Let's do something"; and what he did made news throughout the land.

On the afternoon of Saturday, December 20, 1924, the business district of Madison, Wisconsin, was hit by an unexpected shower of silver. Christmas shoppers seemed to have but one object in life—to purchase goods with bright new silver dollars. The heavy, unfamiliar coins seemed to come from everywhere. Within a few hours there seemed to be thousands of them in circulation. As a matter of fact, there were—seventy-two thousand; and word soon got around that they were all from the payroll of the Burgess Battery Company. Comment on the streets of Madison was varied: "That man! What will he think of next!" "And us—right in the middle of the Christmas rush!" "Well, if Charlie Burgess did it, he must have had some reason."

Charlie Burgess had several reasons. First in order should be mentioned his desire to cooperate with the government. Then there was the element of publicity; the "silver dollar experiment" as it was called would bring added prestige to the name of Burgess. It would also please the people at Philipsburg, Montana, from whom he was buying manganese dioxide; Philipsburg was famed for its silver-mines. But the big idea was to teach the people of Madison, and Wisconsin, a lesson. Once a teacher, always a teacher, Charles F. Burgess wanted to demonstrate to his neighbors that their success depended, more or less directly, upon the development of local industries; that only if industry prospers can the community prosper; that in this modern world, for better or worse, the key to peaceful living is the payroll.

The silver dollar experiment justified itself from every angle. The Treasury Department was pleased; the Rotary Club of Philipsburg sent a long telegram of thanks for "your co-operation in the movement to again place silver on its former high pedestal throughout the commercial world"; favorable publicity reached every state in the Union; local merchants realized as never before the influence of factory payrolls—particularly the Burgess payroll—on the living standards of the community.

Burgess's crusade for a better understanding of industry was undertaken because he felt that industry was being "pushed around" by the State, that is to say, by state taxation. Much of this taxation had been initiated during the governorship of Burgess's erstwhile friend, the elder LaFollette. Almost a quarter of a century had passed since "the governor" had appointed Ida May Jackson as a factory inspector, and Charles F. Burgess as



Niagara Falls, Canada plants of Burgess Battery Company (foreground) and C. F. Burgess Laboratories, Inc.

an oil expert. Meanwhile he had been elected four times to the United States Senate. In 1924 he had conducted a vigorous campaign for the Presidency, supported by insurgent Republicans and Democrats, the Socialist Party, and some members of the Farmer-Labor Party. On June 18, 1925, four days after his 70th birthday, Robert M. LaFollette died. "Though often out of harmony with the Republican Party," said one obituary writer, "Mr. La Follette succeeded in having passed a number of laws of importance to his state and to the nation." LaFollette was particularly proud of his sponsorship of Wisconsin tax laws, and once declared that "Wisconsin . . . leads all the states of the Union in the proportion of its taxes collected from corporations."

As head of two Wisconsin corporations, Burgess felt obliged to view the tax situation with less enthusiasm. He began considering the advisability of pulling out of Wisconsin altogether, as some other industrialists had done. On August 21, 1925, in an "Epitaph on a Departed Wisconsin Capitalist," he wrote:

> He has gone away, he would not wait
> To be badgered to death by the Badger State.

Then, perhaps realizing the limitations of verse, he sought to solve his problems by research. He decided to have the tax situation in Wisconsin and elsewhere studied by an expert, and on September 14, 1925, the following item appeared in the *Capital Times*:

> Paul N. Reynolds, who for the past eight years has been employed by the Wisconsin tax commission as director of the department of municipal accounts and general property statistics, has tendered his resignation effective October 1. Mr. Reynolds has accepted a position with the C. F. Burgess Laboratories in the department of business economics.

The one-man department of business economics went to work without delay. Visiting a number of states, and getting as far south as Anniston, Alabama, Paul Reynolds gathered valuable information on factory sites, labor, and taxes. Then one evening, when Burgess had arrived home from a trip, he found awaiting him a group of business men from Freeport, Illinois, eager to tell him of the advantages of their city as a place for industrial development. Their spokesman was J. Fred Smith, president of the State Bank of Freeport. In a dramatic account of the interview, Mr. Smith later told how the Freeporters marveled at Burgess's knowledge of their city:

> I was amazed at what he knew about Freeport. He said, "Your tax rate is so and so." I did not know it myself. Then he said, "You have (so many) factories in Freeport."
>
> Then he got jovial and said to me, "I know how much income tax you paid last year." I said "This is getting personal"; and before it could go any further, I said "We had better go home and find out something about our own city. This man knows more about it than we do. He has thoroughly digested Freeport."

Mr. Smith's final remark was an unconscious tribute to "the department of business economics."

Plant of Burgess Dry Cells, Ltd. in Winnipeg, Canada

One thing was certain—at Freeport a plant was available. According to Duncan Keith, W. B. Schulte and other Burgess executives, it looked like a very satisfactory plant; according to Paul Reynolds, the economic situation in Freeport was also good. A hitch developed when it came to price. The figure asked for the plant seemed somewhat more than the officers of the company thought they ought to spend, and they returned to Madison. Then Burgess went to Freeport, and soon a telegram was received from him, saying, "We have decided to buy a Freeport plant." To explain this sudden action we turn again to the energetic Freeport banker and industrialist, J. Fred Smith, who relates:

> When we heard that the Burgess Battery people were hesitating about buying a building here, we had a meeting of our people to see what we could do about it. I was chairman. I said, "If we put up about $20,000 to help take care of moving expenses and equipping the plant, it will at least show them that we're friendly. Let's raise it right here. I'll give a thousand. You, there—you give five hundred." And so on; others gave other amounts to make up the total. Within an hour we had it ready to hand over.

This friendly gesture was one of the deciding factors in the move to Freeport, which was announced to Madisonians by the Burgess management in the local papers of December 15, 1925:

> Arrangements have been made for the sale, by the Moline Plow Co., of Freeport, Ill., to the C. F. Burgess Laboratories of Madison, of the property known as "Plant No. 2" in Freeport. This property consists of about five acres of land on the Pecatonica River, with a group of buildings having a floor space of about 450,000 square feet. . . . These buildings will provide for needs of both the C. F. Burgess Laboratories and the Burgess Battery Co., in the expansion of their business, for the consolidation of activities now carried on in separate plants, and for certain new developments which are under way.

Then came a paragraph designed to show that this was not an anti-Madison move:

> It is not expected that this will result in any decrease of the product turned out by the Burgess Battery Co. of Madison, and it is not intended to transfer any appreciable number of the Madison employees to the new plant.

The last statement is important. Burgess often pointed out that he was not decreasing the amount of manufacturing that was being done in Wisconsin; he was merely expanding in other locations where it was cheaper to do business, thus fulfilling the duty of the management to its stockholders. To which it may be added that more than half of the Battery Company's product was being sold outside of Wisconsin.

Two weeks later, when Burgess wrote a cheerful "1925 review" for the *Wisconsin State Journal's* issue of December 31, he made no mention of Freeport. A few words of mild criticism were directed against Madison and Dane County for "not encouraging industry as they should," but in general the tone of the review was peaceful and optimistic. Bur-

gess pointed with pride to "the unusual spirit of harmony and co-operative effort which exists among the 2,000 or more people connected with our organizations, several hundred of whom are stockholders, and the rest employees." He went on to say that in the country at large the wage scale since 1914 had increased less than 100 percent, but that the average Burgess pay in the same period had gone up 161 percent for men, 285 percent for women. And the workers seemed to be prosperous:

> We can look back to a time only a few years ago when it was considered an unusual incident for a worker to drive to his place of employment in his own car, but so common has this practice become that it is a modern necessity for manufacturers to provide a liberal amount of parking space for automobiles. For our own employees it is estimated that about a mile of curb space along our streets would be necessary were it not for the land areas acquired for this purpose.

The tone of the article was summarized in a two-column heading in heavy type: "Optimism Reigns at Burgess Company as Madison Prospers."

As this is beginning to be a tale of two cities, our scene again changes to Freeport, Illinois, just four days later, Monday, January 4, 1926. At a luncheon at the Licondo Hotel, attended by C. F. Burgess, President of the Burgess Battery Company, Walter B. Schulte, Secretary, Vroman Mason, Vice-President, Benjamin S. Reynolds, Treasurer, and others, Burgess acted as host to the Freeport business men who had raised the $20,000 "bonus" to bring a new industry to their city. Congratulatory speeches were made, including one by W. B. Schulte, himself "a Freeport boy." Then came the highlight of the affair, as Burgess, addressing his "fellow citizens of Freeport," thanked them for their fine spirit of enterprise and co-operation, and announced that the officers and directors of his company had decided to return the $20,000 to the men who had raised it, with cordial appreciation and thanks. It is said that at this interesting part of the program, one man slipped from the room and telephoned his wife: "Laura, we can take that trip to Florida now. . . . Yes, on the Burgess Battery Company. . . . They paid back my five hundred dollars."

"Burgess Battery Company Gives Back $20,000 Bonus," announced the *Freeport Journal-Standard;* "Madison Concern will Come to Freeport Without Local Financial Aid." Crowning the page, in large type, were six rhapsodic words: "BREAD CAST ON WATERS IS RETURNED."

While these things were going on, Burgess had been conducting an experiment in public relations. This took the form of a miniature newspaper, printed on Mondays in the Madison *Capital Times.* The first issue of this paper, the *Burgess Bulletin,* appeared on January 19, 1925, with an editorial statement entitled "Our Purpose":

> The purpose of this weekly *Bulletin* is to present information of interest concerning the C. F. Burgess Laboratories and Burgess Battery Company. Our employees are asked to read these columns that they may know more about the business of which they are a part.

> Since it is our ambition to conduct our affairs so that we may contribute in large measure to the welfare of our city, our state, and our country, we hope that this weekly chronicle will include items which will prove to be of interest to our fellow citizens as well as to those more closely connected with our work—C. F. BURGESS.

The *Bulletin,* in part an employees' house-organ, in part a means of company propaganda, was full of human interest. It was read not only by a large percentage of the employees, but by many other citizens of Madison and the surrounding area. In almost every issue there were items of general interest, some of them still so after a quarter of a century. The issue of April 20, 1925, contains an open letter signed by Burgess. It is addressed to Peter Burger, of Madison; it reads in part:

> Dear Mr. Burger:
>
> I wonder if you remember that just fifteen years ago I called upon you to negotiate a lease on the two rear rooms above your hardware store on University Avenue. You asked what these rooms were to be used for, and I explained that it was my intention to start a laboratory for experimental and manufacturing purposes.
>
> Due to your willingness to help this enterprise and because you did not require an advance payment of rent, I have always felt grateful to you. These rooms proved to be the birthplace of the present C. F. Burgess Laboratories, and, therefore, the ancestral halls of the Burgess Battery Company and various other subsidiary companies.
>
> You may have forgotten our early experiments, but I have not, and shall always remember the helpful and kindly interest you took in our work, which for a time proved unsuccessful, but which later led to profitable developments.

Some of the "profitable developments" were now being aided by advertising, not only in the United States, but in the greater part of eastern Canada. A *Bulletin* article on April 6, 1925, mentions that 41 publications are being used, and that:

> Burgess national advertising reaches over thirteen million people in this country and goes into the homes of one out of every two families in the United States. Moreover, in Canada it is calculated that one out of every one and a third families are directly reached by Burgess advertising.
>
> In one series of advertisements, known as "Adventures of Burgess Radio Batteries" and appearing in the *Saturday Evening Post, Literary Digest, Collier's, American Magazine* and many other publications, pictures of the world flyers, the Shenandoah and Los Angeles, the U. S. Battleships, the Leviathan, and many other well-known users of Burgess batteries are shown as convincing proof that where quality is demanded by experts, Burgess Batteries are used. Accompanying these pictures is the statement that "the same Burgess radio batteries which are today faithfully serving the nation's armed forces on sea and land and in the air and used by local broadcasting stations, experienced radio engineers and amateurs, are sold in your community by your own dealer for your own receiving set."
>
> In Canada (which has two Burgess plants), Burgess advertising is appearing in farm and trade journals and in newspapers at Windsor, London, Hamilton, St. John, Halifax, Toronto and

> Montreal. To reach the mass of French-speaking population, French newspapers are used. Last year one out of every 17 families was reached in Canada. This year one out of every one and a third families reads of Burgess products.

Advertising plans for the twelve months starting October 1925 are outlined in the *Bulletin* of October 12, 1925. Sales Manager Duncan Keith, of the Burgess Battery Company, had contracted for space in 1,871 publications, with a combined circulation of over 18,000,000, exclusive of trade journal circulations. The story continues:

> More significant than these figures is the number of times Burgess advertisements will appear in the coming year. This number is 167,000,000. This year the Burgess national advertising will far surpass its previous record.
>
> The number of magazines published in the United States which will carry Burgess advertisements has been increased to 27. In addition to the three large general reading publications, namely the *Saturday Evening Post,* the *American Magazine,* and the *Literary Digest,* Burgess ads will also appear in *Collier's, American Legion, Liberty, Sunset, Atlantic Monthly, American Review of Reviews, Harper's, Scribner's* and *World's Work.*
>
> Space has also been contracted for in 15 fiction magazines, such as *Adventure, Ainslee's, Munsey's, Sea Stories, Short Stories* and others. The list of new magazines gives Burgess advertisements an additional circulation over last year of 6,036,675, and a total circulation for general publications of 12,299,309.
>
> Burgess ads will also appear in boys' magazines such as the *American Boy, Boys' Life, Youth's Companion,* in scientific publications, in trade magazines, and in 1,815 newspapers in the United States. Already space has been contracted for in newspapers in 14 states to reach the people in small towns and on the farms. The combined circulations of these newspapers alone is 1,343,827.
>
> Aside from this extensive advertising schedule in the United States, a far-reaching campaign has been arranged for Canadian publications. Newspapers in Montreal, Ottawa, Windsor, Halifax, Hamilton, London, St. John and Toronto will carry Burgess advertisements. Canadian magazines and trade papers will also be used by Burgess, giving a combined Canadian circulation for its advertisements of 1,165,000.

Burgess took a personal interest in the advertisements scheduled for the *Youth's Companion.* They recalled his boyhood days, when he and Duncan Keith had devoured each issue from cover to cover, always giving loyal attention to the ads. Now other boys could study advertisements featuring *his* name. It was a name not entirely new to *Companion* readers; on at least one occasion the magazine had printed a story submitted by Ida Jackson Burgess.

But getting back to our *Burgess Bulletin,* we note from its issue of July 6, 1925, some items of information about 4DM, the radio station on Burgess Isle, including the fact that the mast for the antennae had been the foremast of a wrecked sailing vessel. Earlier issues mentioned that the call letters of the station had been taken from the initials of its operator, Donald Mix; also that radio communication had soon been established "to all parts of the world."

On August 17 a leading article told about The Burgess Company of Florida, with headquarters at Wewahitchka ("Yes, this is the actual name of a real place"), to be used for the manufacture of various products from southern raw material:

> One of these is vegetable hair or fibre, used as a substitute for curled horse hair in the upholstery trade. It is made from Spanish Moss which grows and hangs in festoons on southern cypress trees.
>
> The plant under construction consists of a fleet of barges with which the green moss is gathered, a motorboat for towing to the central yards and shipping platforms, storage yards where the moss is retted and chemically treated, and a mill where the material is ginned and packed for market.

In the same issue appeared a radiogram dated August 8, 1925, sent to Walter Schulte of the Burgess Battery Company by Commander Eugene F. McDonald, of Zenith Radio fame, second in command of the 1925 MacMillan Arctic Expedition. Transmitted from Station WAP at Etah Harbor, North Greenland, it was received by 9XN, Arlington Heights, Ill. The message ran: "My greetings to you from this fairyland of ice within twelve degrees of the North Pole . . . Gene McDonald."

One of the most interesting issues of the *Bulletin* is that of November 2, 1925, with a photograph of a television set actually in use. Explaining this picture, which was contributed by television pioneer Charles Francis Jenkins, of Washington, D. C., is a story from which we quote:

> A small cabinet has been invented which when attached to a receiving set will project a moving object on a wall or screen from a lens at one side of the cabinet. On the screen is thrown a miniature picture of everything that takes place before a mirror at the broadcasting headquarters.
>
> Voice and music, along with action, can be sent at the same time through the same apparatus. Thus many events, such as sporting programs, plays and dances, can be projected faithfully into the home for the entertainment of those who cannot see the events themselves.
>
> His first Radio Vision Studio is being fitted up by Mr. Jenkins. In a letter to W. B. Schulte, he writes that he expects very shortly "to begin broadcasting from living objects, like dancing girls, clowns, stories in pantomime, and so forth."

Inventor Jenkins, who had been granted about 400 patents in the field of radio, television and movies, also remarked that in his experiments he was using Burgess Batteries; and here are the closing words of the article:

> The Burgess folks are naturally much interested in these developments, and wish Mr. Jenkins outstanding success in the production of this wonderful new field of radio.

24.

Burgess and Labor

"WE believe that a liberal labor policy must be adopted, and in fact we have an eight-hour day and believe in it. We are paying high rates, and hope that we can continue to do so." Charles F. Burgess wrote these words on November 19, 1918, about a week after the signing of the armistice which ended the great war in Europe, when the Burgess Battery Company had suffered a severe setback as the result of sudden cancellation of wartime contracts for batteries. There was much labor unrest in Madison and throughout the country.

"We *hope* we can continue." Burgess could not do more than hope. His best-intentioned plans had sometimes failed. In dealing with men his experience had proved to be much like his dealing with metals—an ever-changing course of trial and error. Early in his business career he had promised himself that he would be an ideal employer, and look for guidance to the Golden Rule. Applying that rule, he reasoned that if he were going to lose his income, he would like to know about it beforehand; and presumably his employees would feel the same way about losing their income. So when he found it necessary to lay off an employee, because of lack of work, he gave a two-week notice, to provide time for the employee to make other arrangements. Now let Dr. John R. Commons, longtime Professor of Economics at Wisconsin, tell us what happened:

> As a result of this bit of idealism, Burgess soon discovered that he was rewarded for his pains by a determined effort on the part of the employee, whenever conditions pointed to the possibility of this plan being forced into action, to string out the job, and thus endeavor to remove the date of discharge as far as possible into the remote future.

Burgess also believed that it was an injustice to grant summer vacations with pay to office employees while the shop people were not granted a similar privilege. Very well; shop-workers were given vacations. What happened then is food for tears or laughter, according to one's point of view. The employees were unanimous in taking the vacation pay, but many of them didn't take the vacation. With old-world thrift they worked two weeks for wages somewhere else. What's

more, some of them worked in a competitor's plant, and a few of them, alas, were never seen again.

"Burgess was bitter." This remark, quoted from a contemporary, is reasonably accurate, but perhaps it would have been better to say "Burgess was bitterly disappointed." He must have wondered what was the matter with these people, who seemed to have no feelings of appreciation or gratitude. Were they the same men and women who seemed so glad to talk whenever he walked through the plant? If so, how could one account for their cold-blooded behavior? Perhaps the answer is to be found in the fact that these people belonged to a generation trained to the notion that capital is one thing and labor another, and never the twain shall meet. From this point of view, C. F. Burgess might be all right as an individual; but as an employer he might be something else, with an ugly name; weren't all employers like that? To Burgess the individual they were grateful for the vacation *pay;* but many of them had not learned how to enjoy a vacation, nor did they realize its value to themselves and to the company. To Burgess the employer they felt no obligation; he was able to take care of himself; they'd do the best they knew to take care of themselves. This feeling was shared by so-called labor everywhere; and a similar inability to see the other fellow's viewpoint was characteristic of so-called capital. Neither had fully awakened to the fact that they were all capitalists, with interests that were identical.

Burgess understood all this, and tried to insure harmony by inviting the workers to share in the ownership of the company through the purchase of stock, offered on an easy payment plan. Such a move, he thought, would dramatize the theory—indeed, the fact—that the real interests of workers and management are the same. Then there would be no conflict, because everyone would be on the same side.

Several years later Burgess reported, a bit ruefully, that only one worker was a stockholder; that is to say, only one worker in the shop; a number of office employees had purchased stock. Evidently the time had not been ripe for sharing ownership with the rest of the employees. They may have feared the risk involved in buying any stock, however good; they may have had confidence in the stock, but felt unable to afford it; some of them may have suspected a capitalistic plot to get them involved. At any rate, they refrained from crossing the imaginary line which separated them from the management. All except Josef Kubiček. Josef Kubiček brought his wife and children from Bohemia to Canada, where they lived for some years, coming to the United States in August 1916. An early employee of the Laboratories and the Battery Company, he was responsible for making the mixes of manganese, graphite, etc., used in the dry cells. Without any prompting, he walked into the office one day and announced that he wanted to invest $2,000, his entire savings, in the company. He did this, as recently stated by Anton Frank Kubiček, his son, "because he had great confidence in Mr. Burgess and felt he could not go wrong in buying this stock." No wonder Burgess liked and respected the man; he was

the ideal employee, who saw the essential partnership between worker and management, and was willing, with his own money, to strengthen that partnership. Burgess often told the story of Josef Kubiček; to him it symbolized industrial progress, based on understanding and confidence.

In spite of the general disinclination of workers to buy stock, the feeling that prevailed was friendly. At the end of World War I, when there were strikes in Madison among machine shop employees, Burgess conferred with the men from his own shop, and agreed to meet the union scale whenever other concerns in town did so. Leaders of the machinists' union, satisfied with this statement, advised their members not to walk out. A comment was made that "Mr. Burgess listened attentively, and seemed to be very fair."

In the fall of 1918, when Madison began to face the prospect of a general strike, Burgess and other industrialists had turned for help to the War Labor Board, and in February 1919 that board recommended several improvements in pay and working conditions. The story of what then happened is told in half a dozen editorials and many news items in Madison newspapers towards the end of March. The *Wisconsin State Journal* of March 28, 1919, editorialized as follows:

> LAYING FIRM FOUNDATIONS
>
> Charles F. Burgess, president of the Burgess Battery Company, has met the full recommendations of the War Labor Board AND MORE. That's real business intelligence and commendable business integrity. It is the sanest possible business move. Mr. Burgess is a real credit to the community, and a man of vision. Cooperation is the cornerstone of success, and he has laid this cornerstone firmly in his foundation.

The *Capital Times* of next day said:

> Mr. Burgess is the only employer affected by the Labor Board decision who has the honor and the vision to stand by his agreement of last fall. . . . Mr. Burgess is deserving of the greatest good will on the part of the workers of the city.

The record shows that the workers did express good will. Paul Huybrecht, state machinist organizer, was quoted as saying:

> If the other employers would only agree to half what the Burgess people have done practically voluntarily, the pending strike would be averted. The Burgess Company put the eight-hour day into effect long ago. The company has done a commendable thing by overlooking the stipulations of the war work award, and including all employees, regardless of age and length of employment, in administering back pay and better working conditions.

Early in the summer of 1918, Burgess workers had been given Saturday afternoons off, the four hours lost to be made up during the week. When Burgess gave back pay to August 1, he bethought himself of the Saturday afternoons, and voluntarily paid each employee time and a half for the extra time worked in making up the half hol-

iday. This brought another editorial from the *State Journal*—the second in two days:

> MAKING THE BETTER MADISON
>
> What a wonderful city Madison would be if all our prospering industrial plants would take the same stand as the Burgess Battery Company, and grant to all their workers the recommendations made by the War Labor Board. But the Burgess Battery Company went further than to meet these recommendations. It established a program that is even fairer than that which the War Labor Board suggested.
>
> If more of our profitable industries were to even approach the program which the Burgess Battery Company has established . . . Madison would indeed become . . . the ideal place in which to live—the city of homes and happiness.

Not all the other concerns were prepared to "approach the program" designed to bring about this idyllic result; and by the 10th of June, 1919, we find Burgess worried because the situation "is still unsettled." On that day he writes to a friend:

> At the present time there is a well-founded threat to declare a general strike; about fourteen of the local unions already having agreed to go out on a sympathetic strike.

But five weeks later, everyone was smiling. Literally. It was "Burgess Day" at Monona Park, the annual picnic of all the Burgess plants; and a highlight of the festivities, as reported in the press, was a contest devoted to broad smiles. Howard F. Weiss almost won; but when the tape-measure was held against his face, it was perceived that he lost by half an inch of smile to Miss Rose Ziegler. The bald-headed race resulted in a tie between two Johns—Kaiser and Bolzt. In the runoff, foreman John Kaiser, then an ardent member of the Machinists' Union, won the bottle of hair tonic. One of the features of the afternoon was a horse-shoe game "at which C. F. Burgess proved to be an expert."

The friendly spirit of the picnic was a reflection of good labor relations; and the spirit of 1919 was still flourishing in 1924, when on December 17 Burgess addressed the Madison Rotary Club on "The Relation of Employer to Employee." After sketching the healthy growth of the Battery Company, he remarked:

> An exceedingly important factor in this development of business, which now engages about 1500 people, is the continuing harmonious relationship which exists between employees and management.

Further on in the same talk, four general rules were given for maintaining satisfactory relations:

> 1. Make no promises, but demonstrate by performance what kind of treatment may be expected.
> 2. Establish conditions so that employees will want to continue for the company, or such that if they leave they will want to come back.
> 3. Make the relationship between the employer and the em-

> ployee so that both sides can understand it perfectly, so that no differences of opinion will arise. This leads to —
>
> 4. The avoidance of all systems of payment based upon bonuses, premiums, insurance, welfare work, or interference with personal affairs.

Burgess's instinctive impluse was to move right into an employee's life, advising, helping, guiding, and even regulating. He sometimes admitted as much. But his wiser second thought, based on research and development in the science of human relations, dictated otherwise. He knew that freedom of action, including freedom to make mistakes, was better than a perfection imposed by persuasion or force. When a friend suggested that he buy building sites and build some homes for his workers, he replied:

> I have seen so many disastrous results come from an employer's trying to participate in building programs for the accommodation of employees, that I have religiously kept away from that kind of investment or activity.

By about the middle of 1926, some of the workers in the battery plant felt that they ought to have an annual vacation with pay, and, as was their custom, they talked it over with "the boss." Burgess was easy to talk to; he was never too busy to discuss problems with an employee. The request for vacations was handed to him in the form of a petition. Apparently nothing came of it; perhaps there were memories of what had happened years earlier, when vacations had been offered and accepted and misused.

Two whole years were to pass before Burgess had another conference with the men. He was very definitely missed. It had been his custom to make frequent walks through the plant, and to stop and talk, sometimes at length, to the older employees. They rather resented the fact that he no longer came around. As a matter of fact, he was very willing to be away from Madison; economic and political conditions in Wisconsin were irritating him. Some of his travels took him far from home, and for several weeks or months. On one of his trips he was in Europe for four months. But there was another attraction which kept him away for long periods, leaving the battery plant in the hands of his assistants. This attraction was his island in Florida, which, with its ambitious building program, naturally claimed a great deal of his attention. When he did appear in the shop again, on June 20, 1928, there was a good deal of comment on his long absence; but never an unfriendly word; and one worker, who had the Burgessian habit of keeping notes, recorded that "A great many of the older employees who know him better are very much attached to him because of his democratic manner and evident human sympathy."

Workers in Madison plants were not allowed to forget that 1928 was an election year, and that they were to vote not only for a president but for a number of officials nearer home. In some plants votes were solicited for candidates favored by the management, but the note-keeping employee in the Burgess plant records that his fellow-workers

"were suited with the policy that had so far prevailed in the Burgess organization, of remaining neutral on political matters and refraining from any endeavor to suggest in any way to the employees how they should vote." This was a policy on which C. F. Burgess insisted.

In December 1929 Burgess wrote an open letter to the Rev. R. W. Barstow, of Madison, who in a sermon had condemned Henry Ford for spending $2,800,000 on the Edison Celebration, "and almost simultaneously dismissing 30,000 men from his factories, putting them out of work at the beginning of winter." Disclaiming any call to defend Mr. Ford, Burgess replied to the sermon because he felt it to be an unwarranted attack on business. After pointing out that the money for the Edison affair was spent long before an unexpected market crash caused unexpected lay-offs, he said that much of the expenditure had been for the employment of labor and for the construction of a mighty exhibit of Americana which would be of permanent value to the nation. In closing, he said:

> May I ask that in your further consideration of the problem of employment you will remember that employer and employee are in partnership, that there is a mutual interest which maintains this partnership?
>
> I could show you that of such wealth as I have, over 90 percent is invested in buildings, machinery, equipment, materials, and funds for the employment of labor, for services to the public, for earning a profit for investors. If the capital is idle the value of it shrinks with great rapidity.
>
> May I suggest that even if you cannot credit us employers with humanitarian instincts, you please credit us with enough selfishness and common sense not to lay off ruthlessly our workers at the beginning of winter. Sometimes sheer necessity forces us to do this.

The Barstow affair was discussed at length by the men in the shop, and the Burgess attitude was generally approved.

Burgess's first large-scale labor difficulty did not come till 1937, when both C.I.O. and A.F. of L. representatives were trying to organize the Battery Company employees in Madison. These were employees of the company's Acoustic Division. On May 26, 1937, the Labor Relations Board ordered an election at the Burgess Battery Co. plant to determine which organization had the right to represent employees in collective bargaining. The election was held Friday May 28, and the result was C.I.O. 166, A.F. of L. 48. A Burgess official was quoted as saying "Everything has been very peaceful and friendly. It's up to them now to come to see us." After a lengthy conference on Saturday June 5, union negotiators left with a company agreement for seniority rights, annual vacations, and recognition, which was about all they had asked except a wage increase, and this the company promised to consider in 60 or 90 days "when the business outlook is clearer." It looked as though matters had been pretty well settled. The company was considering some large contracts, and prospects all around were improving. The union men, however, did not wait, and struck unexpectedly

on June 9, without waiting for the expected contracts to be closed. Some of the hotheads had reasoned that they were in a strategic position and that the company would be forced to grant higher wages to keep the shop going for the expected new work. No effort was made to reopen until they returned to work voluntarily. Burgess was always particular about not violating any of the laws knowingly, whether they referred to labor, taxes or other matters. The strike lasted till July 17, and was then terminated by a settlement similar to that previously offered, including vacations with pay, time and a half for overtime and holidays, 45-hour week, and rehiring on seniority rights. The settlement of wage scales, however, was still postponed for 60 to 90 days. A company spokesman said:

> The bargaining committee of the employees has been conscientious and straightforward, and we know from experience that the great preponderance of our workers are reasonable and conscientious people. We deeply regret that the present situation has arisen.

The immediate outcome of this strike was unfavorable for the workers, because some of them, not living up to their promise, had insisted on a strike without waiting. They had lost 5½ weeks of income, and many of them had temporarily lost their jobs. So much business had been lost on account of the strike, that of 225 employees who had gone out, only about 90 could be promptly taken back.

As the men filed back to work on July 17, Burgess was in no mood to crow over them. In the five and a half weeks of strife just ended he saw a loss to everyone concerned, and everyone received his sympathy. But sympathy, he felt, was not enough. In a statement to the directors of Burgess Laboratories, in which he discussed the strike, he submitted the whole matter to a course of Burgessian research. These quotations from his statement are characteristic:

> Now let us see how a calamity of this sort can be turned to a lasting benefit to our company and all connected with it.
>
> In the first place, we have learned a lot. We have become acquainted with the worker's point of view, with his problems of living on what he earns, with his great problem of insecurity in not knowing when his job may terminate.
>
> We have learned about our own deficiencies in management. . . . It is easy for an employer to pat himself on the back for his interest in the welfare of his workers. He remembers the various times that he has loaned money or otherwise helped individuals in distress; how he has secured promotions for worthy workers, and general advances in pay to the factory employees.
>
> But he forgets the times that he has discharged workers with scant or even no notice; he forgets the times that he has shown favoritism to friends and relatives, to the disadvantage or perhaps more deserving employees.
>
> A wise manufacturer welcomes the receipt of complaints about his product or his service, for by them he learns how to improve his product and his business. But there are few who are wise enough to welcome complaints and suggestions for improvement among their workers, and I am afraid we are in this classification.

Here was an open mind and a genuine desire for industrial peace with justice. Four and a half years later, however, when the United States was deeply engaged in war work and soon to enter the war as a belligerent, the Burgess companies in Freeport went through a strike of greater magnitude. At the outset of this dispute, three unions were involved, an independent union, the C.I.O. and the A.F. of L. The C.I.O. union withdrew, the independent union eventually dissolved, and the A.F. of L. remained. It should be made clear that this strike was not originally against the Company; it started out as an inter-union battle, before any demands had been made on the Company. After the C.I.O. had withdrawn, finding itself in a much weaker position than the A.F. of L., the A.F. of L. continued its picketing and marshalled its forces against the Company. Confusing elements in this strike, which lasted from October 13 to November 25, 1941, were conflicting rights of the various parties, and conflicting interpretations of war-time regulations. Prominent in a movement for reconciliation was Father N. J. Berg, of St. Joseph's Church, Freeport, and Mayor Earl E. Miller of that city. On the night of Tuesday November 18, the Mayor and Father Berg sponsored a town meeting in the circuit court room. Father Berg made "a lengthy plea that the factions settle their difficulties peacefully." The National Defense Mediation Board called company and union officials to a hearing in Washington, declaring that the strike threatened to disrupt production of materials "essential to defeat our enemies." The war foreseen by Edison had come. Two years would pass before it reached America; but Washington could not afford to remain entirely unready. About 250 men now notified President D. W. Hirtle of the Battery Company that they were ready to go back to work, and on November 24 about 300 men crashed the picket line, thus unofficially ending the strike. This same line had been crashed on October 29 by Burgess himself. In his diary he gives a long and detailed account of his daring and somewhat amusing feat; and this, in his words, is how it all started:

> This morning, in bed, got to thinking about this situation at Freeport. The good relations for many years with employees, increased from 250 to about 1000 in 15 years; the pleasant relations with citizens of this city. The indignity of not being able to enter the plant which I have helped to create, of having a government not willing to protect me in the kind of work that I have been doing—the indignity is so great as to overshadow any personal injury I might suffer if I attempt to fight.
>
> So I decided to make a test, to see how far our employees in the picket line would go in fighting my entrance to the plant.
>
> The inspiration was so great that there was nothing else to do. So with no advance notice to anyone, I called up Elmer to take me to Freeport. On the way I told him my purpose was to crack the picket line. He was all for being my right-hand support, but I told him I wanted him to keep out of it—It was to be a one-man affair, with the possibility that he might have to take me to the hospital.

On to Freeport they went, arriving at about 1:30. After due reconnoitering, Burgess, having left Elmer and the car half a block away,

began to walk toward the entrance. Ignoring several pickets, male and female, he reached the gate. There, he says:

> I encountered a picket—a handsome young fellow whom I have never before seen—about 6-feet tall—who held his arms in the air, in front of door, and said "You can't enter here." I replied, probably disconnectedly and possibly profanely, that I was going in. He said, "You are not—this is a picket line."

Then Burgess called to mind his football days. How the coach at Wisconsin used to lambaste the guards for standing up straight; how he used to say, "Don't be a statue on a pedestal; you can be thrown off your balance by a feather." And this handsome young fellow *was* standing up almost straight. So, says Burgess:

> So I suddenly lowered my shoulder—projected against his midriff—made a grab for the door handle, and—thank God—it was not locked. I noticed that another picket at right end was running to his rescue, but I was quickly inside . . . in a passageway leading to another closed door.
>
> In this passage were other pickets—probably two, though it seemed a dozen; and the outside pickets also poured in. I was roughly handled, but suddenly one of the watchmen in uniform said "Do you know who you are fighting—it's Mr. Burgess."

Then he "grabbed the ball, made a run around the left end," and there he was, inside the plant. Once inside, he didn't accomplish very much, except to startle several people who asked how he got in; and to them he replied "I simply cracked the line."

Forty-five minutes later, satisfied with his triumph, he prepared to depart. When he opened the gatehouse door he stood on the threshold for a few seconds, and looked around. At first he saw no one he recognized. Then, noticing the picket with whom he had tussled, he smiled at him; the young man let him pass, but did not return the smile. The notebook continues:

> But on the outskirts were fellows who, I felt, were friends. I then proceeded to proceed. I said "Hello, boys"—and waved my hand to them in a friendly gesture. On the outskirts there were replies and similar gestures.
>
> I then signaled for a path; it was produced; I walked through it, and to Elmer's car. And that is the end of the adventure which I felt might land me in the hospital.

Boys will be boys; and sometimes grown-up men get up to mischief. This grown-up man knew all the time that he was violating his own instructions, to the effect that *no one,* worker, foreman, superintendent, or company official, must try to cross the picket line. He had needlessly exposed himself to danger, and had been pummeled pretty severely until the watchman told the pickets who he was. Then their respect for him as head of the Burgess Battery Company had saved him from further molestation, and from being landed, as he said, in the hospital. His back was lame. And no wonder—it was half a century since he had played football; but, he said:

> I am throwing out my chest over the fact that I am the only one of our organization—either in Madison or Freeport—to disobey the dictation of the Union that no one can enter the plant. I am a bit disappointed that I do not have more sore bruises or lacerations to testify.

Then he went to a restaurant and ate a hearty meal. After visiting a few friends, and doubtless giving them a blow-by-blow description of his encounter, he took the long drive home; and just before he got into bed he wrote a few words in his notebook:

> This has been one of the happiest, most instructive, and most inspiring days I have spent in many years.

The 300 employees who returned to work voluntarily on the morning of November 24 had broken the strike, and their action was in effect ratified when, at an A.F. of L. meeting held on the night of November 25, the strike was called off. The union had asked a wage increase of 20¢ an hour, and accepted 6¢ an hour, the amount which was about to be granted when the strike was called. Under the Wagner Act this raise could not be granted while the strike was in progress. The loss, to company, workers, and war effort, was very heavy; and Burgess made another entry in his notes:

> After 18 years of experience in educational work, and 31 years concentrated on individual development, I have arrived at several conclusions. One of them is that the public is in favor of restricting the activities of industrial development, and, as a corollary, is in favor of giving control of industry and production to the workers in industry.

25.

In Europe and the United States 1926-1929

"UPON recommendation of the Faculty, and by vote of the Regents, I present to you Charles Frederick Burgess, to receive the honorary degree, *Doctor of Science.*" These words of introduction were spoken at the 73rd Annual Commencement of the University of Wisconsin, in the first year of the presidency of Dr. Glenn Frank. They came at the close of an eloquent tribute, the manuscript of which has been preserved:

> Charles Frederick Burgess, chemical engineer, does not come before us because he is a chemist, or because he is an engineer. He comes as a ripe scholar, an accomplished man of affairs, a captain of industry, and a humane citizen.
>
> He was once our colleague, and in that capacity he showed originality and distinction, and left his mark upon the organization of our course of study. He proved to be at home in the laboratory, and out of his studies have come a consistent stream of discoveries and new applications of scientific principle that have brought honor to the University.
>
> It is one of our functions, Mr. President, in addition to the instruction of our youth and the training of our technicians, to pursue the investigations that make the world a better place to live in, and to apply them to life around us. Here Mr. Burgess has achieved a great distinction.
>
> He has built up, upon the basis of pure science and experimental laboratories, a profitable and necessary industry that occupies many of his fellow citizens in a way that is useful to them and us, and that stands upon its merit alone in competition for public favor. It is not a trick of organization; it is not a triumph of advertising; it is a service well conceived and adequately performed. He has profited by it, and so have we.

Charles F. Burgess had often been addressed as "Doctor," and now, on June 21, 1926, the title had been conferred on him officially. Wisconsin, by this gesture, seemed to be drawing nearer to Burgess, but Burgess hardly seemed to be drawing nearer to Wisconsin. He was establishing his legal residence in Florida; and within a few days the plant at Freeport, Illinois, after half a year's preparation, would begin operations with a force of 125 employees. Also within a few days, announcement would be made that the Burgess Laboratories, desiring to escape certain taxes, had changed their legal domicile from Wisconsin

to Delaware. The reasons for this particular move were just and fair; but none the less it was a sign of separation.

Removal of some activities to Freeport did not prevent a healthy output of batteries in 1926. In that year, Burgess stated, "our company made a Voltaic cell for every inhabitant of this country." He was discussing the centenary of Volta's death, which was to be observed in 1927. In his conversations and public talks on the subject of batteries, he often referred back to the work of Volta; and more than once he mentioned that his grandfather Stephen Burgess, of Nova Scotia, was born shortly before Volta did his pioneer work on the Voltaic Cell.

By May 1927 Burgess was saying friendly things about Wisconsin taxes. In a statement to stockholders of the two main Burgess companies, he said:

> I am glad to voice an opinion which I believe is shared by the others in the management of our business, that Wisconsin is not antagonistic to industrial growth. It is true that there are various laws in Wisconsin which are unreasonably burdensome to our company, but the tendency seems to be toward betterment. In 1925 the combined business of the Battery company was entirely subject to Wisconsin income tax laws, while in 1926 only 53 percent of its net income came under Wisconsin control. This diminishing ratio has resulted from establishment of branches outside the state, as well as by a Wisconsin law passed in 1926 which permits a Wisconsin corporation to deduct certain business done outside the state from its total business in computing its income taxes.

Madison newspapers were ready to play up these kind words from a source sometimes regarded as unappreciative. "Burgess says State Friendly to Industry" declared the *Capital Times,* and the *Wisconsin State Journal* headed its story with "States Industry Laws Defended by Burgess."

Burgess's views on the tax situation were not mere notions. They were based on "the records". In this connection it is interesting to note that during part of 1927, Betty Burgess worked in the Laboratories' office in Madison, punching the clock and otherwise observing employee routine. She was busy in the department of business economics conducted by Paul N. Reynolds, and spent part of her time at the State Capitol, gathering data from the official tax records. Her brother Jack worked at the Laboratories for several summer vacations, until 1928 when he joined the Burgess organization for keeps.

May 21, 1927, a young flier who had studied mechanical engineering at the University of Wisconsin, and who had cozily insulated the cabin of his plane with a product developed by Burgess, reached Paris, after a spectacular lone flight from New York. Charles A. Lindbergh was by no means first to fly the ocean; others had done it as early as 1919; but "Lindy" was the first to fly alone, and his well-deserved publicity was reflected in the advertising of various commercial products, including Balsam Wool which will be described later on in our story. Lindbergh's home-coming was signalized by mammoth receptions, particularly one on June 11, in Washington, where he was welcomed by President Coolidge,

and another two days later in New York. Both events were recorded for the eyes and ears of posterity by de Forest's Phonofilm, "in an entirely satisfactory manner, using Burgess dry batteries throughout."

In the summer of 1927, Dr. Burgess and his family spent some time in England. A minor incident of this vacation was the carving of the letters C.F.B. by the owner of those initials, on one of the posts in London's Hotel Metropole. Burgess, accompanied by his son Jack, spent a few days in Italy, where they visited Como, the birthplace of Volta, and probably also the University of Pavia, where for 25 years Volta was professor of physics. Returning from Europe in October, the Burgesses brought news of Betty's engagement to Eric J. L. Cotton, of Earl Shilton in Leicestershire. This romance, which had started on an ocean liner, led to a June wedding, in Evanston, Illinois. It was a happy marriage, followed by happy years of team-work and accomplishment. The activities of Eric Cotton and his wife, and their influence on the Burgess saga, will be recounted elsewhere.

In October 1928, when Dr. Burgess reported to his associates on the business of the Burgess Battery Co., he pointed out that in its relatively short history—less than eleven years—it had made them a good deal of money. Also that it had earned for them "other and intangible benefits," including "an interest in over a million dollars which has been spent during the past three or four years for advertising." Part of this money had been spent on full-page advertisements in the *Saturday Evening Post.* Then he sounded a warning:

> But we must not permit our pride in these accomplishments to dim our view of the future or make us insensible to the problems and dangers ahead of us. There are certain disturbing factors which command our attention.
>
> The growth and prosperity of the Battery Company apparently reached a maximum in 1926, and are now on the decline. . . .
>
> There are two obvious reasons why this condition has come about. One is the great rate at which we and other manufacturers have increased our capacity for manufacturing batteries, and the other is that the users of radio sets are avoiding the use of batteries by the A.C. Tubes. . . . Consequently we are . . . all dressed up and nowhere to go.
>
> This is a condition which cannot be considered a surprise to us. For years we have discussed the possibility and the probability of radio switching away from batteries. We have had several years of warning that this was coming, and the only surprise is the rapidity and the degree with which batteries have been eliminated.

But Burgess was not downhearted. He insisted that in spite of a general shrinkage in dry battery use, "the dry battery business is going to continue"; and he quickly added his reasons for this hopeful statement:

> New uses are to be found, and there will probably be a new lease of life in the use of batteries for radio as soon as set manufacturers realize the extent of the farm market.
>
> There are excellent prospects for the use of special batteries in the talking movie and in television developments. We are engaged in an interesting and most promising venture in getting out new forms of flashlights.

He was probably referring to the Burgess "Snaplite", which was selling in large volume and appeared to be a most promising development.[286]

If the Burgess Battery Co. had its problems, so did its competitors. In 1928, two of them, the Yale Electric Co. and the French Battery Co., suggested a merger with Burgess Battery Co. This suggestion was probably inspired by stockbrokers who were then active in promoting such mergers and in selling stock to an over-receptive public. Burgess could have profited materially from such an arrangement, but he decided "that there is not as good a prospect for increasing our strength by uniting with companies whose problems are the same kind as ours, as there is by joining other lines of business," that is to say, other lines which would supplement the battery business. As an example of the type of concern he had in mind, he mentioned the Thordarson Electric Manufacturing Company, of which one of his old friends was president. He pointed out that "Their products were adaptable to storage without deterioration, and would make it possible to adjust production so as to reduce the valleys which we now have in our business. . . . The periods of slack work do not exactly coincide." Also considered was the proposition of joining with a manufacturer of radio sets, under an RCA license; but again Burgess decided no, "because in this field of constant change we would be trailers and not leaders, the hazards being greater than we would wish to assume."

Then, as a child looks for help to its mother, the Burgess Battery Company looked to its parent, the C. F. Burgess Laboratories, and help was forthcoming. The Laboratories, for years engaged in developing products for others to manufacture, licensed the Battery Co. to make "Straight-Thru" mufflers, and the battery plant was enabled to use its surplus plant and surplus labor by making sound-absorbing equipment, as described more fully in a later chapter. But this was not all; for in November 1928 the Battery Co. was helped to a much greater extent, by transfer to it of the Laboratories' business in making battery raw materials. This business included the production of sealing wax and battery mixes, the preparation of manganese ores and other materials; and with it was transferred also the battery testing and research laboratory. The transfer was made on the basis of the book value of the business, with no profit to the Laboratories. Burgess was confident that the Battery Co. ought to prepare its own raw materials, and that in the end both companies would be better off; but most of the Laboratories' directors, seeing the Laboratories deprived of a profitable business, opposed the move, which resulted in considerable disagreement.

Late in July 1929, Dr. Burgess again felt free to spend several months abroad. He sailed on the first eastbound trip of the German liner *Bremen,* which had just established a new transatlantic speed record. Among the many celebrities who sailed with him was the daughter of a Leipzig janitor. Burgess, keenly interested in people who had "made good," probably knew something of her history; how, with some natural talent, much hard work, and her own artistic kind of research and development, she had earned a place for herself as one of the world's most

satisfying coloratura sopranos. From a distance he watched her as she sat writing a letter, and soon he was writing about her to one of his friends:

> Altho I am sitting in the same chair which but a few minutes ago supported the fair form of Frieda Hempel, I don't seem to have absorbed any of her artistic temperament.

It was the whimsical remark of a man who has temporarily left work behind him, and who is beginning to enjoy an unaccustomed sense of relaxation. Relaxation of the 100% loafing type was unknown to Burgess; all he expected was change of scene, some of it within a few miles of Betty's new home at Earl Shilton in Leicestershire. On August 10, 1929, Burgess and his wife, with Eric Cotton and Betty, motored to the near-by town of Ashby-de-la-Zouch, and there went through the ruins of the castle made famous in Scott's *Ivanhoe*. Burgess, a confirmed handicrafter, was doubtless interested in the chapel, where old-time masons had "signed" the stones they laid, marking them with triangles, arrows or crosses. He probably noted also the quaint plumbing arrangements of medieval times, designed for the most part without benefit of chemical engineering.

Early in September 1929, in one of several letters from London to his friend and financial adviser Paul N. Reynolds, Burgess spoke of the buying fever on the stock market, and added, "As the stocks stand today, I bet we can pick them all up at a lower price within the next three months." Late in October came the crash, with selling on a scale never before approached.

Another letter from London, also to Paul Reynolds, discussed England and the English:

> I find that I am getting pretty well acquainted with London, even more than some Englishmen I know.
>
> My wife asked me today if I could be contented if I had to live over here, and I answered by confessing that I seem to be contented wherever I happen to be.

These comments were characteristic. Burgess thought little of location, much of action. London to him was a fascinating, many-sided object of research—and of development:

> The more I look into things over here, the more I am convinced of the opportunity for Americans in Europe. They have little competition in willingness to work. The Englishmen are just as keen about money as we are—but not so willing to work for it —excusing themselves by thinking they are leading nobler lives.

A few weeks after penning these words, Burgess made it clear that at least one American was not going to stay in England, regardless of opportunities. Soon he was writing to one of his friends, "I am anxious to get to headquarters," and headquarters was still in Madison, where, he said, "I could sit down at my desk without feeling that I have been away." To give force to this remark, he added, "Will be rolling back about October 1."

October was going to be a busy month; but what month wasn't, in the life of Burgess? There was work, and more work, and another wedding. This time the family gained a daughter, when, on Saturday October 19, Jean Elizabeth Thomas became the wife of Jackson Burgess. To Dr. Burgess and his wife this was the big event of a year filled with big events. It was a solemn and joyful occasion, a fitting basis on which to build many happy memories.

With the sound of wedding music still in his ears, Dr. Burgess found himself on a train speeding toward Dearborn, Michigan, whither he had been invited by Henry Ford as one of a group of distinguished Americans to take part in a tribute to Edison. The date was October 21, 1929, fiftieth anniversary of the invention of Edison's incandescent electric lamp. It was a grand and glorious publicity stunt for the electric light industry, maneuvered by press agent Edward L. Bernays, nephew of Sigmund Freud. Blithely ignoring Genesis 1, 3, the affair was called "Light's Golden Jubilee." The United States Post Office more correctly called it "*Electric* Light's Golden Jubilee," but smashed all precedent with a gift of free advertising, boldly picturing Edison's lamp on a two-cent stamp. President Hoover was Honorary Chairman of a committee which as one of its activities circulated free copies of a song by George M. Cohan, entitled "Thomas A. Edison, Miracle Man" ("Moping, groping in the dark, without him we would be!"). Minor celebrations, sponsored by the Edison companies, were organized throughout the land. Burgess must have enjoyed the Bernaysian audacity of it all. At any rate, he entered heartily into the spirit of what turned out to be a world-wide salute to his friend and Florida neighbor, the venerable and typically American dean of all inventors.

Burgess would not have missed the gathering for worlds. It brought together so many of the important people of *his* world, old acquaintances and new. Famed railroader L. F. Loree was there, none the worse for a thrilling iceboat ride thirty-five years earlier with the Burgess boys. Marie Curie was there, she whose need for radium in 1904 had prevented Burgess from getting a supply of that dangerous element, and this, as told elsewhere, had probably saved his life. Burgess was especially glad to meet Dr. Lee de Forest, of radio and talking-picture fame. He had exchanged a few letters with de Forest, but valued this opportunity to talk things over; and there were countless things to talk about. The two men, born in the same year, had watched the march of science from different viewpoints. As they compared notes, they compared personalities, and each gained inspiration from the other. At Dearborn Village they had themselves photographed by a tintype man. The picture was pretty awful, but it would serve as a souvenir of a good time, so they accepted it as such, and promptly titled it "Charlie and Lee."

On Thursday, October 24, 1929, three days after the big doings at Dearborn Village, big doings of another kind were noted and recorded by one of Burgess's Madison friends, George A. Boissard. In a letter written years later, Mr. Boissard recalled:

> I happened to be in Chicago, at the Edgewater Beach Hotel, at an insurance confab. I went down into the lobby to get some cigars, and when I saw people coming out of a broker's room on the lobby floor with white faces, I knew the jig was up.

Nearly thirteen million shares changed hands that day on the New York stock market. Bankers, after conferring with J. P. Morgan, declared that business was "fundamentally sound." President Hoover bravely thought so, too. Within a few days the bottom dropped out of the stock market, and on October 31 the nation's principal exchanges closed for the week. Meetings were held throughout the land, as worried directors of corporations asked one another, "What do we do now?" One of Burgess's friends remembers such a meeting, and gives us this account of it:

> Within a few days after the financial crash of 1929, a meeting was held in Madison, which C. F. attended, between members of the Laboratories' officers and representatives of an outside group financially interested in a new process on which the Laboratories was doing development and in which the Laboratories had a small interest.
>
> These representatives, who were in the metal business, had been hit very hard because of the big drop in the price of metals, and at this meeting they were very glum.
>
> There was talk of the length of time that the low prices would endure. Nearly everyone except C. F. predicted a recovery before Christmas. C. F., however, did not agree, and pessimistically predicted that this would not be a short-time depression, but that it would last at least five years, and that we had only seen the beginning of it. And C. F. was correct!

Shortly before Christmas, 1929, word came from London that Dr. Charles F. Burgess had been elected a full member of the Royal Institution of Great Britain, on the proposal of four members, including his friend Sir Robert Hadfield. No Christmas present could have been more welcome. The Royal Institution was founded in 1799, "to encourage research, to spread the principles of inductive and experimental science, and to promote the application of such principles to the arts." Burgess himself might have written those words. Enrolment in this august body seemed to bring him into communion with other members, who, in other days had done so much to implement the charter. Now indeed he was a colleague of Davy, and of Faraday.

26.

Burgess Battery Company 1930-1932

IN the Spring of 1931, Dr. Burgess became a grandfather, twice. Betty's first child, Charles Burgess Cotton, was born on April 14; Jackson's first, Annette, came on May 7. The proud grandfather amused himself by pretending that the babies were rivals. Some months later the Cottons received a cablegram from him, with the challenging announcement, "America beats England by a tooth." Eric and Betty pondered on what to reply; then they cabled back, "Congratulations—but can America say Dada?"

The Springtime gave, but it also took away. It gave to Burgess two new little ones, and took from him a tried and trusted friend. On May Day, death came to Duncan Keith, boyhood comrade of the old news-route days. Keith, the Battery Company's vice-president and one of its directors from the beginning, had also held important posts in the related companies. Five years younger than Burgess, he had always been a wise and prudent counsellor. Perhaps the quality of his service can best be sensed from a remark made years later by a friend of both men: "Keith was a sort of balance-wheel for C.F." Duncan Keith, born in Canada not far from the old home of Burgess's parents, was only 53. His loss was felt deeply. Writing to a friend, Burgess said:

> Mr. Keith took his business responsibilities, and, in fact, all other responsibilities of life, most seriously, and it is because of his ability and sincerity that our business has grown.*

As he made his exit, Duncan Keith seemed to be needed more than ever. The demand for dry batteries was still shrinking; the downward trend, first noted in 1927, persisted. As the entire industry was affected by this slump, no discredit was attached to any individual concern, but each concern was forced to do some more or less drastic retrenching. In 1930 Burgess, hoping that the battery business would rally and not need his close attention, had made his headquarters in New York, establishing there an office and a laboratory (see Chapters 32 and 33). Late in the year, however, sales were dropping rapidly, and in 1931 the Battery Company was no longer operating at a profit; indeed it

*Keith, a name of good omen throughout this Burgess history, was also traditional in the family of Jean Elizabeth Thomas, wife of Jackson Burgess. It was happily renewed in the christening of their son, Thomas Keith Burgess, born November 20, 1949.

was soon losing $1,000 a day. Before leaving for Europe in August 1931, Burgess had a serious talk with his brother, George H. Burgess, of the firm of Coverdale & Colpitts, in New York, and asked him to make a study of the Battery Company and submit a report together with a plan for getting it once more on a solid basis. The report, dated December 4, 1931, showed that it was uneconomical to manufacture batteries in both Freeport and Madison. In accordance with the report's recommendations, the battery work was then concentrated in Freeport, and the Acoustic Department was returned from Freeport to Madison. As it turned out, the acoustic business did not develop as hoped, and was not sufficient to put to use profitably the large amount of floor space available in Madison, and the strain on Battery Company finances, though greatly reduced, continued.

Conditions were admittedly bad; but even as he turned to his brother for expert and neutral advice, Burgess was not depressed. He regarded the slump, severe as it was, as evidence of a normal trend, based perhaps on changing needs. New needs must be met with new service, and Burgess was convinced that new service could be rendered by dry batteries. In 1931 he wrote to a friend:

> With the marvelous things that are being done with electrons, ions, and subcosmic things, it is difficult to keep our mind on the lowly dry cell, but I still think there are many undeveloped uses if we seek to find them.

He often found them. The Battery Company had just acquired and put on the market an ignition booster for automobiles, and it was operated by "the lowly dry cell."

If dry cells could have talked, those bearing the Burgess label would have resented the title "lowly." They had been exalted to preeminence, by an authority himself preeminent. Down in Florida, where distribution had been poor, Thomas Edison had insisted that hardware stores carry Burgess batteries. He had used them, he liked them, he wanted them kept in stock. A boost like this was most encouraging. It got talked about in the trade; one dealer after another said, "If they're good enough for Edison, they're good enough for me." Burgess was delighted. In his diary he made a brief note about a story he would like to write, entitled:

EDISON ONCE WORKED FOR US AS A SALESMAN

Edison's work, for himself and others, would soon be carried on mid new surroundings. In 1931, on October 18th, he died. In the guest book at Burgess Isle he had penned a sort of farewell credo: "We do not know one millionth percent about anything."

Edison had reached his 85th year. Burgess, only 58, felt young and vigorous, a feeling shared by his associates. He and they, undismayed by business recessions, managed to hold on to their independence. In 1931, the Burgess Battery Company was again invited to consider a merger with another manufacturer of dry cells, this time with the Bond Electric Company, of Jersey City. One aspect of the proposal was mildly dramatic. For a number of years the head of the

Bond Electric Co. had been Conrad Hubert, Burgess's old adversary of "tungsten battery" days. Now, three years after Hubert's death, his firm was seeking union with Burgess. After due consideration the proposition was turned down, but not for personal reasons. Relations between the Bond and Burgess concerns were then cordial, and so continued.

Late in the summer of 1931, unburdening his mind of financial and manufacturing problems, Burgess betook himself to England, there to enjoy one of the greatest treats of his life. For an entire week in September he took part in the celebration of the centenary of the discovery of electro-magnetic induction by Michael Faraday. The Faraday celebrations were sponsored by the Royal Institution of Great Britain, of which Burgess was a member, and the Institution of Electrical Engineers, with the cooperation of many learned and industrial societies. Dr. Burgess attended as official representative of the American Electrochemical Society, and was a guest at several very elaborate functions. It is hardly any exaggeration to say that all the notables of the scientific world were present, and in the crowds it was often difficult to move without nudging a Nobel Prize winner. On an envelope in Dr. Burgess's file devoted to this inspiring event are some penciled notes for an informal talk by him. One of these notes reads "If it had not been for Faraday we would still be using voltaic cells" (that is to say, *only* voltaic cells). This was a dramatic statement to come from a man engaged in the manufacture of voltaic cells in the form of dry cells, the use of which had been so greatly decreased by the event he was celebrating.

On January 8, 1932, when Dr. Burgess made one of the most important speeches of his career, describing that career in some detail, he did not mention batteries until the very end, and then only briefly. Batteries were important; but so were some other things.

The January speech, entitled "Research 'For Pleasure or for Gold,' "[33] was made in accepting the Perkin Medal, awarded annually by the American Section of the Society of Chemical Industry, for the most valuable work in applied chemistry. The presentation to Dr. Burgess was made for "Work on electrolytes, electrolytic iron and its alloys; metallurgy of zinc, corrosion of iron and other metals, and development of the dry cell." The medallist in turn paid tribute to "the brilliant and able men and women with whom I have had the good fortune to be associated," and added, "it is with those who have worked with me that I wish to share the honor of this award." Many letters of congratulation came in, and in answer to one of them he wrote:

> Rather than feeling elated over the award, I am impressed with my limitations. The credit which I have for mechanical and engineering work, especially in the last ten years or more, comes from my being associated with men who are doing good work, and I do not know a better group of scientists than that with which I am associated.

When Springtime came, Burgess was again crossing the Atlan-

tic, and one day, as he sat in a comfortable chair on the *Bremen,* he thought up an invention for which the credit was all his own. A sketch in a notebook depicts it as a cigar wrapper of cellophane so formed as to be easily removable. The invention probably went no further than the notebook stage, but for a few minutes at least it furnished fuel for an active mind.

In September 1932 The Electrochemical Society announced that it was conferring upon Charles F. Burgess, one of its most active and helpful members, an honorary life membership. Memberships of this type are sometimes awarded when a man is going on the retired list; but no one thought of Burgess as retiring. Right now, indeed, he was busy acquainting himself with the electrochemical possibilities of a hitherto unused ingredient in dry batteries. This material, an acetylene carbon black known as Shawinigan Black, had just been called to his attention at one of the meetings of The Electrochemical Society, by R. A. Witherspoon, a friend and fellow member since 1902. Acetylene carbon black was not entirely new; as early as 1915 a patent on its use in dry cells[291] had been issued to a German named Philipp Burger. Some years later, Burgess Battery Company and other battery manufacturers in the United States had received samples of the German product, but their engineers had not been much impressed with its value. Possibly it was different in some important respect from the Canadian product of 1932; at any rate, it was made by a different method. Mr. Witherspoon had remarked that his company, Shawinigan Chemicals, Ltd., of Shawinigan Falls, Quebec, was producing the black substance on an experimental scale, and had wondered if it would be of use in dry cells. It had been offered to other battery manufacturers, and they had not been receptive, perhaps because it cost a good deal more than graphite. Burgess's normal interest in the new material was spurred by the knowledge that his competitors had passed it up. He virtually pounced on it, and was soon convinced that it was a real find. He discovered that a small amount of Shawinigan Black could replace a much larger amount of graphite, and that therefore the additional cost per pound did not matter. In a letter to Mr. Witherspoon he said "Your material ought to be basic raw material for our industry." Not long afterwards he wrote:

> Of all the improvements I know about, relating to dry batteries, I am inclined to pick out as the most important a new material made not far from Montreal. It is known as Shawinigan Black. Some people call it acetylene soot.
>
> It is highly conductive electrically, and it has a remarkable property of absorbing liquids—one pound of Shawinigan Black we find will absorb 20 pounds or more of water or aqueous solutions. These properties happen to be of particular value to the dry battery—for the conductivity is essential, and the ability to absorb liquids makes a battery dry while holding a maximum amount of useful electrolyte.

Just as Burgess had greatly improved the output of dry cells when he discovered that impalpable graphite was an improvement over the

form of graphite originally used, so did he effect a similar improvement over the impalpable graphite by recognizing the value of Shawinigan Black. Then he had the pleasure of writing to Mr. Witherspoon:

> Some of our competitors have followed our example, and we are entitled to a bit of the credit for having helped to add to your sales.

Mr. Witherspoon agreed, saying "As an actual fact, you did more than we did to uncover the possibilities of Shawinigan Black." Numerous other uses were found for the new product, several of them developed by Burgess.

Meanwhile a number of things had happened since the fall of 1931, when, as we have seen, Burgess called in his brother George to act as business engineer for the Battery Company. George H. Burgess, representing Coverdale & Colpitts, made a number of recommendations, and in December 1931 the Battery Company's board of directors voted to accept them. This meant drastic changes in the operation of the company. One of the changes, most distasteful to Burgess, involved the laying off of many men at a time when jobs were very scarce. The move was unavoidable, but it was not enough. Battery sales continued to drop in volume, prices were low, and further retrenchment became necessary. To make matters worse, the company was hit hard in January 1932 by the death of its chief engineer, A. J. Helfrecht. Mr. Helfrecht, an expert in battery manufacture, had been with Burgess since the summer of 1915 when he graduated from Wisconsin, and at the time of his death was on the Battery Company's board of directors.

In May 1932 the Laboratories and the Battery Company were forced to cut wages and salaries of virtually all employees. Cuts ranged generally from 10% to 15%, but salaries of officials and higher-paid executives were reduced drastically, some as much as 75%. Burgess's own salary at his insistence, was almost eliminated. The Battery Company cut its sales force by 33% and made heavy reductions in advertising appropriations. The Laboratories contributed by cutting the royalty rates on acoustic products licensed to the Battery Company from 5% to 1%. Even with all these economies the board of directors was advised that the Battery Company would not be operating with profit.

On December 12, 1932, an important change was made in the management of the Battery Company. Burgess became Chairman of the Board, having asked his Brother George H. Burgess to assume the presidency. "George had the advantage of being unprejudiced, and a stranger." This remark, made by one who remembers the circumstances, is enlightening. When painful changes have to be made, they come with better grace from one who is relatively neutral.

For a time things looked promising, and then a sad discovery was made. Early in 1933 customers began to complain about poor batteries, and their complaints mounted rapidly. Then came the realization that the quality of the product had suffered; and the very heart of the Burgess business was its devotion to quality. The main cause of the slip was an

effort which had been made to cut manufacturing costs by using a cheaper type of zinc can. Too late it was discovered that the zinc was of inferior quality. Many carloads of poor batteries had to be scrapped at this critical time, but not before a considerable number had reached the consumer.

However, inferior zinc was not the only cause of the trouble. In the effort to cut costs there had been a temptation to depart, perhaps slightly, from time-tested manufacturing procedures, and to buy cheaper material that "almost" met specifications. Because the change was gradual, the decline in quality was at first not evident. This was unfortunate, for until an error is seen it cannot be corrected; and by the time this one was seen it had grown to the proportions of a crisis. The lesson of 1933 was the same lesson that Burgess had been teaching throughout his business career—that high quality can be insured only by constant watchfulness; furthermore, that this watchfulness must extend into all the details of laboratory testing and manufacturing procedure.

Strangely enough, the first plain statement about the deterioration of his products came to Burgess from a keen but not unfriendly rival. The rival, visiting Burgess's Florida home, was a former Wisconsin engineering student, William W. Cargill '16, who had gone to work for the French Battery Co. in 1920, and now, at the age of 38, was president of that company's successor, the Ray-o-Vac Company. Cargill told Burgess that his product was definitely becoming inferior; and Burgess could not help being grateful to the bearer of bad news. Sales were dropping steadily; and now beyond a doubt he knew the reason.

Early in 1933, at the request of his brother, Burgess gave up his cherished New York laboratory. He returned to Freeport, where he could again be close to the manufacture of cells, working hard to reestablish the quality of the product which bore his name. Characteristically, he set the former good quality not as a goal, but as a starting point. "As good as before" would not be enough; the slogan now would have to be "Better than ever." Once more he was in harness, just as in the days long past when he had put the French Battery & Carbon Co. on its feet. Burgess faced his individual crisis at a time when all industry was facing a national crisis. Now came the New Deal and with it some new and unaccustomed headaches.

The political expression "new deal" was not new; it had been used by famed forester Gifford Pinchot as early as 1909, and by others as far back as the year of Burgess's birth. But the New Deal proclaimed on July 2, 1932, when Franklin D. Roosevelt flew to Chicago and accepted nomination for the Presidency, was more than a catch-phrase; it was a new conception of government, which, for better or worse, would encourage government to meddle more with business. The men who formulated New Deal policy came to be referred to as the Brain Trust. Burgess had his own brain trusters, skilled in the arts of research and development. In building and administering his business, on lines that were unquestionably progressive, he had created his own new deal, and doubtless did not wish to have another version imposed on him from above, by men who, no matter how well-intentioned they

were, lacked his years of specialized research and hard-earned experience.

Even in cases where the New Dealers blundered—which in Burgess's view was pretty often—he could not unreservedly condemn them. After all, they were researching, and they were developing! Not a few of them were from his native State, or even from his Alma Mater. And he could not forget that among the many cooks who had stirred up early helpings of the New Deal broth was a respectable and well-meaning young man named Charles F. Burgess. As he wrote to one of his friends, "Possibly if I continued in the line that I first started, I would be one of the Brain Trusters." One day, before the Rotary Club in Freeport, he made a clean breast of it. Discussing the new activities of government in the field of social relations, he said:

> I come from a state which has been a leader in this type of experimentation. Much of this work is done at the University of Wisconsin, where I was a teacher for eighteen years. During part of this time I was a lieutenant to Governor LaFollette, with a minor part in some of his projects of government control.

A third of a century had passed since Burgess had served the elder LaFollette, "that great champion of the masses," as an oil expert. A quarter of a century had gone by since, under the Wisconsin Public Utilities Law, he had laid out rules and standards for gas and electric light companies, initiating reforms which soon were nation-wide. Those old experiments, in their day viewed with alarm, had brought results of lasting public benefit. But the reform movement of 1933 was on a much more comprehensive scale, and, the speech continued:

> Something seems to have gone wrong with these experiments. The (first) World War happened, our great depression came about, our leaders say that something radical must be done to restore prosperity, and they lay down for us a lot of new formulae, calling it a new deal.
>
> The brain trust back of this new deal frankly states that many of these new orders are experiments, which must be tried out in the hope that they will work. And we must all "do our part." Thus by government decree we must interest ourselves in experimentation.

Burgess did interest himself, and to the best of his ability he did his part. Because of the suddenness of many of the changes deemed necessary, this co-operation was often difficult, even for business men who were "100% Franklin Roosevelt Democrats"; and Burgess was a Republican. He liked to describe himself as progressive; he was surely independent; in 1912, as a gesture of confidence in university scholarship, he voted for Woodrow Wilson. In 1928 he voted for Al Smith, probably because of Smith's attitude on the liquor question; this in spite of the fact that in 1916 he had worked hard for the dry cause. His change in policy was not a change in aim. He was really in favor of national *sobriety,* and by 1928 he had come to the conclusion that where prohibition had failed, moderation might succeed.

Although he strongly opposed many New Deal measures, he admired New Deal audacity in experiments, regardless of their outcome. He used to say, "Blundering is a necessary adjunct to experiment." He agreed with Benjamin Franklin that "It would be better if government meddled no farther with trade than to protect it"; but he did not believe in protective tariffs, which he regarded as mere subsidies in restraint of normal trade. In voting for Wilson he did not turn Democrat, nor can it be said that he was a typical Republican. In two great wars he knew no party politics; in the nation's hour of need he gave without stint of his time, his money, and his energy, not as a Republican, not as a Democrat, but as a burgess—a *free citizen*—for that is what "burgess" meant in days of old.

27.

Burgess Battery Company 1932-1936

ONE of the first actions taken by George H. Burgess when he became President of Burgess Battery Company was to engage D. W. Hirtle as superintendent. Mr. Hirtle had been with the American Rolling Mill Company, of Middletown, Ohio. Before taking over his new duties he had a three-hour talk with Dr. Burgess, in the course of which he stressed the fact that his experience had been in steel, and that he knew "absolutely nothing about the manufacture of dry batteries." Dr. Burgess summed up by saying "The only thing I can say good about this fellow is that his people came from Nova Scotia"; but he said it with a smile, and the new superintendent was made to feel that his appointment was approved by the Chairman of the Board. "C. F. liked him right away," commented George.

Everyone was busy; none more so than C. F. Burgess, whose new title of Chairman gave no hint of the efforts he was expending in his grim task—the task of restoring to Burgess Batteries the quality which had made "Burgess" a symbol of excellence. 1933 was a year of reformation, and in spite of varied obstacles, political and economic, it was a year of progress. While Dr. Burgess worked on batteries, his son Jackson, who also had moved from New York to Freeport, was directing a continuation of some interesting experiments in electronics which had been started in the New York laboratory. Development of the Micro Switch was also continued, soon followed by the first marketing of that device, referred to elsewhere in our story. These might be times of crisis, but the Burgess tradition must be upheld, research must go on.

One day in the Fall of 1933, Charles and Ida Burgess received a welcome message from England, announcing the birth on October 11 of John Williams Cotton, their third grandchild, the second son of Betty and Eric. But while the third generation grew apace, the first had many problems yet to solve. Some of these problems grew out of the activities of the new national administration; and in December 1933 Burgess wrote to a friend:

> I have not much faith in many of the policies being tried out in Washington. . . . This battery business is still in a turmoil, and we are all quarreling about prices of our product, the N. R. A., and other things.

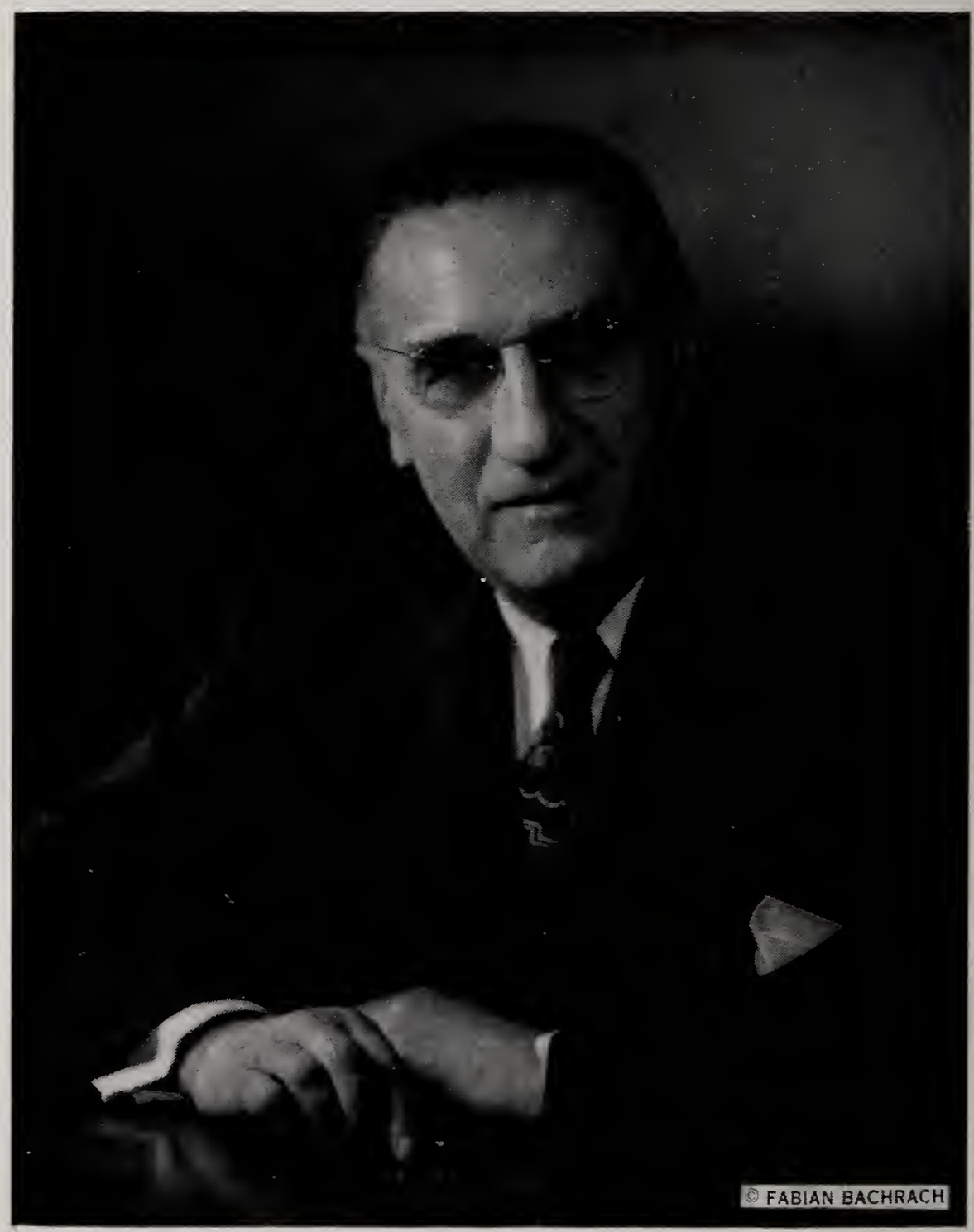
In March 1934, in a letter to Julian S. Gravely, of the Winchester Repeating Arms Co., a similar note was struck:

> The N. R. A. situation does not make development work very easy or attractive. . . . Our battery business has been shrinking continually, and about a year ago I began devoting a great deal of time to it. I find it as interesting a product as it ever was, with plenty of opportunities for improvement and development.

As its name implied, the National Recovery Administration, or N. R. A., was intended as a means for promoting recovery. Some of its provisions, for example, those concerning labor, were readily accepted in the battery industry, and proved to be workable. Others, especially those dealing with sales policy, simply would not work in the highly competitive battery business; they may have been included in the law at the request of individual industrialists, but they definitely did not fit the conditions of the entire industry. The experiment of legalized price-maintenance under the mantle of N. R. A. was a failure. When a schedule of minimum prices for batteries was about to be agreed upon, one of the producers was unable to come in on the arrangement until he had left the meeting to consult with his largest customer, a mail-order house. Returning, he agreed to the schedule, but reserved the right to allow an extra 10% discount to mail-order companies. Burgess agreed, but countered with the statement that he too must be permitted to grant a special 10% to any customer who might be entitled to it because of volume of business or for other reasons. Both exceptions were allowed. But before very long the industry found itself plagued by a war of discounts; one manufacturer said he would have to allow 15%, another said 20%, and in time one member reserved the right to grant 40%. Even that was not the end, for another member insisted that he be allowed to scale his price down to the very cost of production.

Burgess did not believe in price-fixing, which he regarded as being contrary to nature, whether attempted by government or by private agreement. To him it was an instrument of monopoly, and therefore not in the public interest. He had been willing to try it under N. R. A. only because it was the law of the land; and after it had been tried and found wanting, he was glad when it was abandoned. He had never relaxed his efforts to put the business back on its true foundation, the foundation of unquestioned quality; working hard with materials and methods, and harder still with men, he now had good reason to feel optimistic. No difficulties, with the N. R. A. or any other unfamiliar agencies or conditions, would ever chill the Burgess optimism. Ida knew this, and in some notes made at this period she recorded it, along with some other comments, wifely, loving and revealing:

> Charles seems as mentally alert, as keenly interested in new things and new ideas, as he was thirty years ago. The only hints I get that he is changed are that he is impatient with those who do not stride along with him. Sometimes I think he is deeply hurt in his pride when he feels that the younger men are a little



Kenneth F. Burgess

> resentful of his activity in the company; though his philosophy tells him that the next generation is always treading close at our heels, seeking a foothold. But Charles is a wonder to me. . . . He has grown more alert and more interesting and vital.

Mrs. Burgess knew what she was talking about. There *was* occasional trouble with "the younger men," who, trained and encouraged by Dr. Burgess, now claimed a certain share of independence. It is true that they were not always ready to "stride along with him"; sometimes they wanted to stride in directions that were decidedly different. But they were only "a little" resentful of Burgess's dominating activity; and his counter-resentment was tempered by his philosophy, and by his keen interest "in new things and new ideas."

If Burgess and his associates disagreed on some internal policies, they showed a united front to trouble from the outside; and such trouble in the battery business was not rare, as explained in a letter Burgess wrote to a friend in May 1934:

> If you have any desire to get into a line of business where you have to deal in a highly competitive way with a first-class bunch of cut-throats and pirates, I might see what can be done about getting you into the business of making dry batteries.
>
> The way which we have chosen of fighting these battles is through quality rather than a price product, and to get the quality we are dependent not only upon the use of the highest grades of raw material, but upon finding how to use them in the most advantageous manner.

To Burgess and to his organization this insistence on quality was a tower of strength, supporting their morale, and making new friends for them, through good times and bad. Bad times there were aplenty, shared by the entire industry; and rumors spread throughout the industry about sales or mergers of various companies. One rumor introduced the name of Burgess; then a letter came from Mr. J. A. McEvoy, of S. H. Kress & Co., New York, stating that a tale was afloat about plans of the Burgess Battery Company to sell out to another concern. Sometimes Burgess was slow in answering a letter; but not this time! He promptly wrote to Mr. McEvoy, October 4, 1934:

> There is no place in any of my plans for either the immediate or distant future, of selling out or otherwise disposing of our dry battery business to any other company.
>
> I have had such an enjoyable time in this work that I am not for a moment thinking of retiring from it. Many new developments are under way in the direction of improved products, and so many new and important uses for dry batteries are appearing over the horizon that I believe that it is one of the most attractive lines of business that can be found.
>
> A policy which I am pursuing intensively is to improve the quality of our product.

By 1934 it could be said that Burgess batteries were again of Burgess quality. Furthermore, several new types of battery had been devel-

Chidnoff

George H. Burgess

oped, and were now being placed on the market. Progress was hindered, however, by the price-cutting war, which went merrily on, and Burgess finally came to the point of formulating a New Deal program of his own, including a number of reforms, some of them within his organization and some affecting relationship with jobbers and dealers. In general the reforms involved strict adherence to price schedules and elimination of unprofitable products.

One of the unprofitable products dropped was the standard No. 6 ignition cell, for which was substituted a battery made up of four flashlight-type cells connected in parallel. The new battery, which came to be known as the Little Six, was more compact than the old No. 6, and more flexible. Dropping the conventional No. 6 was unpopular in the trade, because the Little Six did not look as powerful as the old battery, and dealers complained that they would lose customers. Then, a month after dealers and salesmen had said a reluctant farewell to Old Number Six, they were distressed again, when Burgess Battery Company announced the discontinuance of its second-grade batteries. This decision came after the company's chief competitor announced a drastic cut in its price for second-grade B batteries—a cut which brought the price right down to Burgess's cost of production. Rather than meet the cut by reducing quality, Burgess dropped his cheaper line, and resolved to go ahead with one grade only—the best. Jobbers complained that this decision was hard on them, because now they could not meet the competition of the cheap line, which had just become even cheaper. So Burgess faced a market that was still demoralized, and customers who were almost unanimously discontented. The difficulties of the situation were great, but for some time he had been thinking about a plan to overcome them, or at least to lessen them.

While he worked on his plan, along lines soon to be revealed, his interest in other people and their activities continued without limit, extending even into the stratosphere. In September 1934 he contributed $1,000 toward the expenses of a flight into the stratosphere by Dr. and Mrs. Jean Piccard. The undertaking appealed to him, perhaps because it involved the overcoming of difficulties. The Piccards were to go aloft in a spherical "gondola" built of magnesium alloy furnished by the Dow Chemical Company. Their flight was a project in scientific research; their spirit was the spirit of adventure. Mrs. Piccard, choosing diet suitable for celestial explorations, took along some angelfood cake. The flight was made October 23, 1934. The Piccards sailed from the Ford Airport, Dearborn, Michigan, early in the morning, and landed in mid-afternoon near Cadiz, Ohio. Eager for human-interest angles in an otherwise somewhat scientific story, newspaper men gave wide publicity to the angelfood cake, and so, says Dr. Jeannette Piccard (for she also has a doctor's degree), "We have always carried angelfood cake on a balloon flight since."

While Dr. Piccard was experimenting with travel above the clouds, Dr. Burgess was conducting research in transportation on the nation's highways. Transportation was an important factor in his plan for meeting new conditions. Instead of distributing batteries through jobbers,

as heretofore, he wanted to establish a fleet of trucks, and make delivery direct to the retail dealers. This was against the custom of the trade, and against the policy advocated by most of his associates. In 1934, however, he started the experiment with a couple of trucks in Florida, where distribution through jobbers had been poor. In Florida the results were somewhat favorable. Some of the dealers gave the Burgess delivery trucks a hearty welcome; they couldn't forget the good work done years earlier by Burgess "salesman" Thomas A. Edison. Dr. Burgess spent several days riding on one of the trucks, and was thrilled to see the actual sales being made, with sales talk, order, delivery and collection all over within a few minutes. His plan was working; now he could declare his independence of the jobber.

The new program was not an easy one, but it had the merit of flexibility—a flexibility which permitted the sale of top quality merchandise without the millstone of a cheap line designed to meet competition. In April 1935 ten trucks started out from the factory, and by July 1938 the fleet had grown to 62 trucks, operating throughout the middle-west, south-east and Texas areas.

"Do not refuse to sell our product to any customer" had been one of the plans in Burgess's own New Deal Program. This principle was applied uniformly, even to jobbers, when they agreed to meet the Company's terms without exceptions. In general the direct-to-dealer plan antagonized the jobbers, but some of them continued to handle Burgess batteries; and as it turned out, in many fleet territories the jobber distribution actually increased; this increase was largely in the case of specialty distributors, many of whom now copied Burgess by sending out trucks of their own.

Fleet selling was a success. In a manner both dramatic and effective it promoted a line composed of solely high-grade products undiluted by unprofitable second-class merchandise. It overcame many obstacles; some of the states imposed prohibitive license fees, not only for the trucks but for doing business in the state. Some cities and towns classified the truck delivery men as peddlers, and harassed them with local fees and restrictions. And still the plan was a success. Then World War II, with its imperative demand for batteries for the fighting forces and its dislocation of the normal activities of industry, nullified the plan. Fleet selling was abandoned, a victim of force majeure.

In November 1934, in the early days of the truck experiment, Dr. Burgess spent several weeks in London with his wife, who had crossed early in October. Walter B. Schulte also crossed the ocean, and the two men had some memorable times together, particularly when they visited one of Burgess's shrines, the Royal Institution, and there saw the famous notebooks of Faraday, including the historic Entry 61, of August 29, 1831, where Faraday described the experiment in which he proved that magnetic action could produce an electric current. Mr. Schulte said, in a recent interview, "Except for the fact that Faraday gave his notes serial numbers they were much like C. F.'s." If he made the same remark to C. F., as he naturally would, it was one of the best compliments Burgess ever received.

Early in December the travelers were on their way home, as indicated by a note made by Mrs. Burgess:

> . . . back to this country and straightway to the island, to be greeted on the very day of my arrival with the news of the coming of our fourth grandchild—Jack's second daughter—Betty Jean. So there is again a "Betty Burgess."

Betty Jean was born December 8, 1934. Her grandfather was then supposed to follow his custom of wintering on the Island, but, as told by his wife, he was absent for weeks at a time, "flying down for a few days of the life he loved here, and then back again to the grind." "The grind" consisted largely in steering the Burgess Battery Company through the difficulties caused in the industry by price-cutting.

As often as possible, Dr. Burgess flew down to the Island to be with his wife, whose health had not been good for several years. Illness in New York in 1931, and in Madison a year later, had robbed her of some of her strength. Early in June 1935 she went north to Madison, and there, soon after her arrival, she suffered a heart attack which kept her in the hospital for over two months. Of this period she wrote:

> So the Summer of 1935 is a nightmare of doctors and nurses and ambulances, and long, long weeks in the hospital. And Betty coming over from England to be with her father, first in the apartment, and then later with us both in the hotel.
>
> She will never know what her coming meant to both of us . . . while I struggled back to something like my old self.

The days of convalescence were happy ones. The recovery was slow, but none the less it was recovery, and by the spring of 1936 Mrs. Burgess was indeed "her old self" again.

On March 28, 1936, George H. Burgess, having done a good job in making what he called "necessary changes," resigned as president of Burgess Battery Company, and C. F. Burgess, who had invited him to make the changes, resumed the presidency. On the next day word came of the death of a great and good friend, Magnus Swenson, just before reaching his 82nd birthday. Not so long afterwards, in the middle of July, Burgess learned that Carl Hambuechen, on a train bound for Chicago, had suffered a stroke, and on July 31, Hambuechen died in a hospital at Springfield, Illinois, aged about 61. A loyal friend and valued colleague had made his exit, and to Burgess it must have almost seemed as if a door had been closed on one of the most significant phases of his career.

28.

Thordarson Story and Burgess Battery Company 1936-1941

ONE summer day in 1936, Dr. Burgess received a visit from an old acquaintance, Chester H. Thordarson, President of the Thordarson Electric Manufacturing Company, of Chicago. Thordarson had founded his company in 1895, the year of Burgess's graduation at the University of Wisconsin. As early as 1896 some Thordarson equipment was installed there, in the Electrical Engineering department; and right to the end of Burgess's years at the University, Thordarson was furnishing special transformers of various types, particularly for Burgess's work with electric furnaces. An amusing encounter of the two men at the St. Louis Fair of 1904 has already been mentioned. But now they talked but little of the past, for Thordarson had something else on his mind, as recorded briefly in one of Burgess's many notebooks:

> C. H. Thordarson called on me. He was in great physical, mental and financial distress, all of which came about through the fact that his business, T. E. M. Co., was deeply in debt; the creditors had formed a committee to take over and manage the business. This committee was preparing to put through a reorganization by which the former owner would be practically eliminated, and his valuable historical library, which had been mortgaged as security, was in prospect of being confiscated.

Burgess listened with sympathy and indignation. He felt that the creditors' committee was "bearing down" too hard. After asking a number of searching questions, and getting some interesting and detailed answers, he told his old friend that "the problem is a most interesting one, and far from hopeless." He felt sure that a man whose fortune had at one time been rated "way above the million mark" need never regard himself as a failure; especially a man who had rendered valuable aid to electrical science and industry. In effect, Thordarson was advised to stop worrying, and "to let us see how we can work out of this."

Thordarson began to feel relaxed and reassured, not only because he had been told to quit worrying, but because he knew that Burgess had an uncanny power to solve difficult problems. And once, long years before, had he not seen Burgess perform a miracle? The memory of that incident was a good omen. Thordarson smiled. Then he said, "I don't feel so worried now about the business. But I'm still worried about some-

thing else—something that's been troubling me for over thirty years. And only you can set my mind at rest." "All right," said Burgess, "Fire away—what is it?" "Well, when you visited my stand at St. Louis in 1904, how on earth were you able to tell when I turned the current on and off?" Burgess laughed. "I cannot tell a lie," he said, "That wasn't a miracle; it was a trick. Look here—take a look at this hand." Thordarson inspected the hand; one finger looked as though it might have been in an accident at some time; otherwise everything seemed normal. Then, at long last, Burgess explained. Over forty years earlier, when he was working at the Walker plant in Cleveland, his hand had been injured by a milling machine, and an iron shaving had been forced into his finger, there to stay for the rest of his life. The shaving was large enough for its outline to show plainly when the finger was held in front of a strong light. "So," concluded Burgess, "When I held my hand in the electrical field above your machine, I knew every time you turned on the current, because the iron in my finger began to warm up." "Well, I'll be———," murmured Thordarson; and the interview which had opened on a solemn note was brought to a cheerful and hopeful close.

Now Dr. Burgess's real task began. To restore health to his friend's finances would take more than an iron shaving; it called for quick diagnosis and a prompt prescription; once more, research and development. Research brought out the fact that one of the principal creditors had refused to join the hard-boiled creditors' committee, and had wanted to take steps less drastic and more helpful. Burgess was glad to note that this merciful creditor was the Acme Wire Company, of New Haven, Connecticut, whose president was one of his former electrical engineering students, Thomas G. Nee '99. Burgess promptly wrote to Mr. Nee, and received a long, co-operative reply, the spirit of which is seen in one short paragraph:

> We feel, as you do, that the Thordarson Company is not at all hopeless. In fact, it should again be able to take its place in the industry where formerly it was the ranking company. With improving conditions a new financial set-up should be possible.

A new financial set-up *was* possible, and before long it was in operation. It involved the merger, which, as we have already mentioned, Burgess had considered as early as 1928. Again quoting from one of the faithful notebooks:

> An exhaustive study of Thordarson's situation was made by auditors, and a plan was worked out whereby Burgess Battery Co. financed the retirement of the outstanding indebtedness and became owner of the common stock. Thordarson became owner of the preferred stock, and President of the company, and the plan involved his recovery, over a period of years, of the mortgage on his library.
>
> We did some guessing and planning, which pointed to the possibility of getting the business on a profitable basis on a three-year plan. In doing this we were guided by the fact that our dry battery business was closely allied with the radio and electronic field—the same field with which the T.E.M.Co. product fitted. It was a logical combination of interests. We believed that the

Blank & Stoller

C. F. Burgess—1939

same principles of operation in effect with Burgess Co. could be applied to the T.E.M.Co., with mutually beneficial results.

The Thordarson Co. was very popular in radio circles, as a result of catering to the radio amateurs, popularly known as "hams." It therefore had for its customers many young men who were likely to become leaders in the radio and electrical field. Thordarson efforts and Burgess efforts were distinct but strikingly parallel; Burgess wanted to bring them closer together, and then perhaps to initiate or revive some important lines of research. Some idea of what he had in mind may be gathered from a few very brief quotations from a statement kindly contributed by a friend:

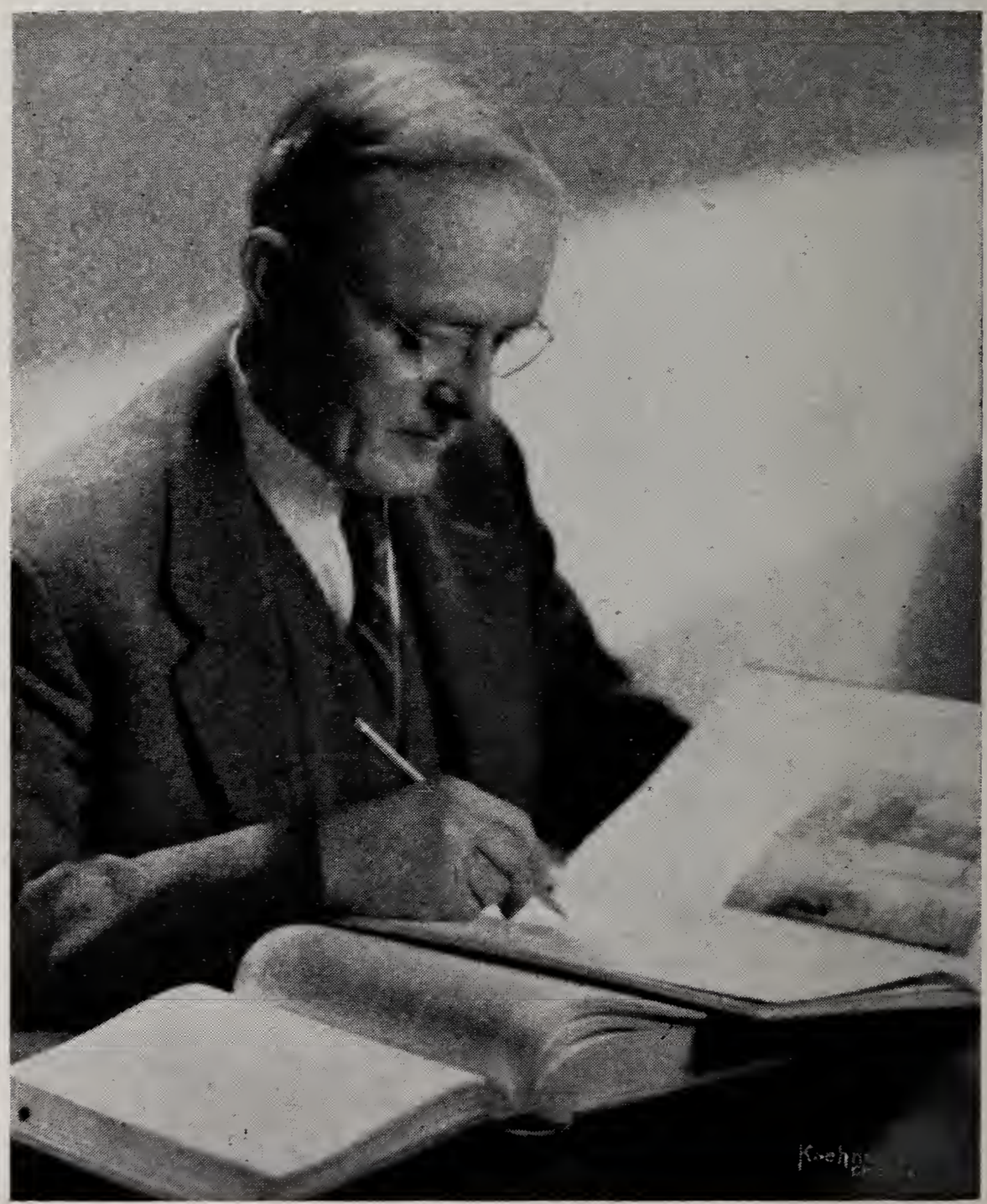
> The Thordarson Company was making electrical products, and C. F. was an electrical engineer.
>
> The successful operation of transformers and particularly the operation of high-efficiency transformers depended upon the use of iron alloys. Some of these alloys had compositions close to those which he had made and studied under the Carnegie grant; in fact, he was of the opinion that his work under the Carnegie grant was to some degree responsible for the advances made in the transformer art.
>
> He therefore saw the opportunity of again taking up the study of iron alloys as a means of advancing the interests of the Thordarson Company.

In 1936, when all this was happening, Burgess was keenly interested in the work of Harry A. Ford, who was conducting research on the use of powdered iron for electrical purposes. He backed up this interest by becoming a substantial stockholder in the Ferrocart Corporation of America, of which Mr. Ford was president. He believed that powdered iron could be used for greatly increasing the efficiency of electromagnetic devices, including transformers, and that one of the raw materials for the production of powdered iron could be his own electrolytic iron. Although World War II and other causes prevented the carrying out of this attractive program, the expectations awakened at the time added zest to Burgess's efforts to aid his friend Thordarson.

The Thordarson Company, as a division of the Burgess interests, was in a position to render fine service in World War II, turning out large quantities of electrical equipment for the armed forces. The entire facilities of its plant were used for producing transformers and other items for the government, and the name of Thordarson continued to earn respect.

The Thordarson plant was at 500 West Huron Street, Chicago, and in 1938 the Burgess offices, for some years in the Harris Trust Building, were moved to the Huron Street address, where plenty of space was available. The resultant saving of money was welcome, as the Battery Company was having a poor year. On New Years Day 1939, Dr. Burgess wrote to his brother George:

> The showing made by the Battery Co. and its divisions for the past year has been disappointing. We have gone into the red. I do not look for a business boom to pull us out of the hole this year.



Chester H. Thordarson

> What improvement comes must be by exercise of the best business ability we possess, coupled with reductions in expenses, and practice of all the economies possible.
>
> It is on such a program that we are already launched, and the most gratifying feature is the unified and earnest efforts with which most of our men are plunging into the program.

Plunging into the program was expedited by D. W. Hirtle, who had become Vice-President of the Burgess Battery Co. in March 1937, and President in March 1938, succeeding C. F. Burgess who again became Chairman of the Board, with plans in mind for many years ahead. Some of the plans for 1939 were on a large scale. In July of that year Vice-President Benjamin S. Reynolds of the Battery Co. was preparing to visit New Zealand and Australia, to study manufacturing and selling conditions. As it turned out, the time was not propitious. Mr. Reynolds landed in New Zealand on September 1, 1939, but on the same day Adolf Hitler marched into Poland, and business plans were spoiled throughout the world.

One part of the world at least was free from Hitler's baneful influence, and that was Little America, down at the base of the world, near the Antarctic ice barrier. Thither towards the end of 1939 went Admiral Richard Byrd, on one of the most ambitious polar expeditions of history; and thither he took with him a nice assortment of Burgess batteries. These were designed for portable and emergency lighting equipment, for weather-recording devices, for telephone and radio communication, and for other special uses. Perhaps he needn't have taken quite so many, for when he reached Antarctica he uncovered a supply of Burgess batteries which had been left there ten years earlier. Seeking to determine the effect of their decade of hibernation, he warmed them up—and they still gave satisfactory service. Byrd was pleased; Burgess was happy; apparently nobody was surprised.

Because it had been found that flashlights, when used at 60 or more degrees below zero, gave only a dim light, a new kind of headlight was furnished this expedition. This was used with a novel type of battery, the "ribbon battery," designed by Walter B. Schulte.[265] Such batteries were carried strapped beneath the clothing, so that body heat kept the cells at working temperature. Admiral Byrd's two vessels, the *North Star* and the *Bear,* sailed from Boston December 15 and 22 respectively. The expedition reached Little America on January 11, and soon distinguished itself by charting 150,000 square miles of hitherto unknown territory.

Christmas in 1939 was not as merry as usual; at least, not in the home of the Burgesses. They couldn't help thinking of Betty and Eric and their children, in an England that was facing total war bravely, but sadly unprepared. Then, on the day after Christmas, word came from Madison of the death of an old friend, Dr. William Snow Miller, who had started teaching anatomy at Wisconsin in 1892, and who since 1924 had been Professor Emeritus. Although not a chemical engineer, Professor Miller was a very learned man, from whom Burgess had learned a great deal. At one time Burgess had lived in his home; and in his passing, another

link was broken with the past. On April 6, 1940, death came to Burgess's own family, and took John Gabriel Heckman. "Uncle Gabe" was his mother's brother, the one who had worked at Lynn for Professor Elihu Thomson.

July 7, 1940, Howard F. Weiss died. A valued friend and associate, Mr. Weiss had been for many years with the U. S. Forest Products Laboratory, whence he had come to the Burgess Laboratories in 1917. Since 1938 he had been president of the Research Products Corporation in Madison, of which more is told elsewhere.

Early in 1941 two other friends were taken. On the night of February 5, in Los Angeles, Vroman Mason died. Vroman Mason '95, a friend of Burgess from his first year in Madison, had been intimately connected with the Burgess companies. He had served the Laboratories as a director, and for some time as Vice-President; for many years he had been a director of the Battery Co. Until about 1930, when his health began to fail, he had been a valued legal adviser. Just before his death he had showed a visitor an article he had been reading with interest; it was a story about his friend C. F. Burgess. A few weeks later, March 18, death took Louis Kahlenberg. This was another blow. When Kahlenberg retired from the University he had spent a good part of each year with his son in Florida, near enough to Burgess's home there for the two to get together, smile at the memory of bygone controversies, and strengthen the bonds, never really broken, of their oldtime friendship. Burgess wrote to a friend: "I have occasionally reviewed my past experience, and can pick out a few individuals to whom I feel grateful for having furnished valuable assistance. Dr. Kahlenberg is near the head of the list."

Old friends passed on, and left gaps that were hard to fill; but Burgess kept busy, and reasonably happy. What with national and international changes, with politics and war, the running of a business was adventure. And in May 1941, as if current activities were not enough, a Handicraft Store was opened in Chicago, with the purpose of giving an added meaning to the name of Burgess. As to whether it succeeded in that purpose will have to go over to another chapter. It is mentioned here as one of the novelties of 1941.

Another novelty concerns the performances of a parachute jumper. This man, A. H. Starnes, thrilled the public by dropping many thousand feet before he opened his parachute. He used a number of instruments for which the Burgess Battery Company contributed batteries, and gave a lecture in the Handicraft Store which attracted a considerable audience. Dr. Burgess, always interested in new stunts and in "nerve," made a generous donation to what he called "the good cause."

Correspondence with the parachute jumper went on till the end of November. A week later, on Sunday, December 7, news came of the Japanese attack on Pearl Harbor, and America was brought into the war.

29.

Burgess Laboratories' Activities 1918-1925

AND now we must turn back the hands of time, and imagine that instead of standing at the threshold of World War Two, we are still with the Burgesses in Madison, in the final year of World War One. It has to be this way; for while the battery business was developing, as told in our last seven chapters, a thousand other things of note were happening, and many of these are clamoring for their rightful place in our story.

One bright day in the Spring of 1918, a telephone call came to the C. F. Burgess home at 416 North Livingston Street. A voice not heard for seven years said, "This is Paul Isobe . . . I am in Madison . . . I should like to come and see you." The immediate answer was "Come on over!" and the little family waited expectantly, to see what their friend would be like after a long sojourn in his native land. They didn't have to wait long. Very soon a taxi appeared, and out of it stepped Paul Isobe, clad in smart morning attire. Over his shoulder he was carrying a bundle, which seemed to have four corners. He was bearing gifts, and they were wrapped in ceremonial Japanese style.

After the first words of greeting and welcome, everyone sat down: Mrs. Burgess, Paul Isobe, Betty and Jack. Paul learned that Mrs. Burgess was quite active as a part-time reporter; she had been appointed publicity chairman for the Women's Committee, Wisconsin State Council of Defense. Dr. Burgess, also busied with duties relating to the war, was in New York; in a few days Paul would meet him there. Meanwhile, as recalled by Betty, "He loaded down Mother and me with silks and satins; then he seemed to realize that he had given nothing to Jack, so he put his hand in his inside coat pocket, pulled out a handful of gold pencils, and said, "Take one of these!" One of the "silks and satins" was a gorgeous orange satin kimono for Betty, with Isobe's crest on it. The little girl saved it carefully, and took it with her when, as a bride, she went to England. It is still one of her treasures.

The reunion was a delightful experience, for guest and hosts alike. It was followed by an equally satisfactory one in New York, where Dr. Burgess was waiting at The Chemists' Club. There the two men talked about the wartime advancement of chemical industry in America, and about the fixation of atmospheric nitrogen in the form of compounds useful in industry and agriculture. The main purpose of Paul's

H. F. Weiss, C. F. Burgess and W. B. Schulte in front of Laboratories' building in about 1923-4 (left to right)

visit was to acquaint himself with new developments in this field. He had reached the United States in time to take part in the 33rd General Meeting of the American Electrochemical Society. This had taken the form of a tour through the principal industrial and power centers of the Appalachian South. On May 2 the members and guests had visited Muscle Shoals, and had seen some of the progress being made there toward establishing a large nitrate industry. Much of the time had been devoted to the enjoyment of Southern hospitality, and to a program of speech-making, which, according to the Proceedings, included a friendly and constructive talk by "Mr. Isobe, of the Suzuki Company, one of Japan's great commercial companies." Now, in New York, Paul expressed the desire to return to Muscle Shoals for a more detailed inspection of the great nitrogen-fixation plant being installed by the United States Government; and Burgess used his influence to get a permit for this purpose. Recalling this aid, years later, Dr. Isobe wrote: "It was certainly of great value to me."

In the course of several conferences with his old professor, Isobe gained a great deal of valuable information, but nothing was said on either side about consultation fees. Some of Burgess's associates said to him, "Why don't you charge Paul for what you have been doing?" The question was a proper one; but somehow "C. F." couldn't bring himself to the point of mentioning money to his former student and protégé. Then one day, when the two were about to part, Burgess towards Madison and Isobe towards Tokio, Paul quietly remarked, "Mr. Burgess, I am about to go back to Japan. You have given me no bill, and I want to pay you." Burgess hesitated, then said, "Whatever you want to give us is all right." Paul immediately proffered an envelope which presumably contained some bills. Burgess accepted it with thanks, and put it in his pocket unopened, not realizing that it contained $2,000 in hundred-dollar bills. In later years he liked to tell how he had to break one of the bills to pay for his railroad ticket; the fee had come just in time to relieve a severe shortage.

Some men feel ruined the moment their bank balance begins to decline, but Burgess was not easily depressed, for life to him was always full of promise, and he was kept busy and cheerful by never-ending research. He was becoming deeply interested in chemurgy, and the big problem now was how to make use of wood wastes. As to how this problem was solved can be told briefly in Burgess's own words:[33]

> Back in World War I, cotton became scarce, even for such important needs as surgical dressing. . . . Burgess Laboratories created a blood-absorbent white surgical dressing from wood. . . . Then the armistice came, and need for developing new uses for this attractive material.
>
> The material was found to have unusual properties against heat and cold—the biggest prospective use being the insulation of houses. For this use, cheapness was a requisite—obtained by omitting the bleaching—using not the highest but the lowest grade of woody material, including sawdust and bark.
>
> From this effort came the organization of Wood Conversion

Betty Burgess Cotton

> Company, their turning of sawmill waste into a new and useful product, and the world-wide distribution of this insulation under the name of Balsam-Wool.

The research on Balsam-Wool was initiated and conducted by Howard F. Weiss, who brought to the task his years of experience with the U. S. Forest Products Laboratory. Mr. Weiss obtained patents[266] on Balsam-Wool in April 1920, and in the same year, in cooperation with the Weyerhaeuser lumber interests, the Wood Conversion Co. was formed. This was a Minnesota corporation, organized to manufacture Balsam-Wool and another product developed by Burgess Laboratories known as Nu-Wood;[267] mills for the enterprise were built at Cloquet, Minnesota. Actively identified with this development, both before and after its acquisition by the Wood Conversion Co., was "Pat" Norris. He went to Cloquet and got the new plant into operation. All of the machinery was of a new type, and some time was spent in getting the equipment to operate smoothly, which, thanks to Mr. Norris, it eventually did.

The Laboratories received a stock interest in the Wood Conversion Co., and continued to serve that company in a consulting capacity. Balsam-Wool was advertised in picturesque language as "The Woolen Underwear for Homes," and eventually reached the dignity of page and double-page spreads in the *Saturday Evening Post.* In describing Nu-Wood, the sawmill by-product, Burgess said:

> By modified milling methods, another product, a stiffer, board-like material, was evolved, by a process defined as "making boards ten feet wide and a hundred feet long from trees three inches in diameter."

Balsam-Wool was soon found to possess valuable sound-absorbing properties, and how these were used will be told in a later chapter.

At about this time something happened that caused Burgess a good deal of concern, because it involved his taking sides against Herbert H. Dow, his friend ever since the early days of the American Electrochemical Society. As Burgess put it:

> A set of circumstances developed which placed me in the position of a so-called "expert" in a patent suit brought by him against a competitor in the manufacture of bromine.[308] This position was not to my liking, as I was lined up against a man whom I considered a friend.
>
> All during the lengthy trial, conducted before a court in Detroit, where we daily faced each other as opponents, he never showed toward me the least sign of resentment.
>
> If I should be asked to name the greatest sports I have known, at the top of the list would be H. H. Dow. At the end of the trial he invited his opponents to visit him and his plant at Midland, a most unexpected and unheard-of act of fairness. To those who accepted this invitation an absolute absence of resentment was evidenced, so much so that it only increased my embarrassment that we were lined up on opposing sides.

Jackson Burgess

Burgess and Dow remained on the best of terms. Theirs was a friendship that could not easily be shaken.

In June 1924 the Burgess Laboratories took a full-page advertisement in Jackson Burgess's high school paper, quoted here in full because it gives, in brief form, an idea of the wide scope of the organization's activities:

C. F. BURGESS LABORATORIES
Chemical Engineers

Investigations for manufacturers of chemical, metallurgical, paper, and wood products.

Development of processes for the utilization of waste materials.

Operators of mines for the production of manganese compounds.

Operators of mills for the production of manganese compounds, zinc anodes, carbon flour, graphite, and paper specialties.

LABORATORIES AND MILLS
1101 E. Washington Ave., Madison, Wisconsin
2010 Pennsylvania Ave., Madison, Wisconsin
Chicago Office.....Harris Trust Building

In the Fall of 1924, Jackson Burgess, as his father had done before him, went to the University of Wisconsin, and on September 26, C. F. Burgess was writing the good news to his old friend George A. Boissard, of Madison, adding, "Jack has settled upon his future career by affiliating himself with the Beta fraternity." Betty also had just entered the University, where, on special occasions, she would soon be able to wear a party frock from Paris; said frock having been selected for her at 31 Rue Tronchet by a jury consisting of Mr. and Mrs. Boissard and other experts. In a note of thanks to Mr. Boissard, Burgess said:

> It was certainly good of you to spend some of your valuable time in selecting this merchandise, and I would really feel guilty, if it were not for the picture which has been presented to me of your sitting in line while numerous models paraded before you. Perhaps as a matter of fact, you owe me something instead of the reverse.
>
> I am sure that when the dress arrives it will properly adorn my daughter . . . She is having a wonderful time with the various rushing activities.

Burgess was proud to see his children following in his scholastic footsteps. He was also proud of the fact that right now he was able to be a benefactor to his Alma Mater, by supporting a line of research of value to the University and to society, yet totally unrelated to his commercial interests. In this connection a somewhat amusing situation arose, involving Burgess, his literary classmate Zona Gale, and Professor Michael F. Guyer, eminent zoologist and student of genetics.

Burgess met Professor Guyer in Madison, at the X Club, which is not as mysterious as it sounds, for, as stated by Professor Guyer, it was "a small dining club—a more or less fluctuating social group—which met once a month for dinner and an evening of discussion. It was made up of University men and professional and business men who were not in the University. The latter were mainly of the legal

Mrs. C F. Burgess—1925

profession (including two judges of the State Supreme Court), physicians, and the heads of industrial organizations." At one of the meetings of the X Club, Dr. Guyer gave a talk on his experiments in connection with the treatment of cancer. Burgess was greatly interested, and shortly afterwards—again in the words of Dr. Guyer:

> He sent a check for $2500 to the University secretary with the instruction that it was to be used in any way I saw fit, to further my investigations. It was wholly unexpected on my part, and came like a bolt out of the blue, but it was very characteristic of the man, I think. Instead of talking about it, he *did* something.
>
> The gift enabled me to buy a first-class ultra-violet machine, and also permitted Professor Farrington Daniels and me to go ahead with experiments on cancer irradiation with cathode rays in which we were interested. The results of these studies were published in *The Journal of Cancer Research,* Vol. XII, No. 2, June 1928, pp. 166-187.

So far, so good. A man of good will was trying to help others of his kind to serve mankind. But they hadn't reckoned with womankind—at least not with Zona Gale, who, since 1923 had been on the University's Board of Regents. Zona, herself above suspicion, was resolved that her University should be likewise, and she is credited with having caused the Board to adopt a resolution, 9 to 6, "That no gifts, donations, or subsidies shall in the future be accepted by or on behalf of the University of Wisconsin from any incorporated education endowments or organizations of like character." Under such a ruling in 1904, Burgess would not have been able to conduct his famous electrolytic iron experiments under the Carnegie Institution grant; and without later incorporated endowments, including one from the Rockefeller Foundation *still effective in* 1925, other research projects, of value to the University and to society in general, could not have been successfully carried out. *Chemical and Metallurgical Engineering,* in its August 1925 issue said:

> From what ills or entanglements or moral turpitude the regents hope to save the University by their action, does not appear; but evidently some bogey is to be done to death by a blunderbuss shot at corporate wealth, regardless of consequences.
>
> A state university is almost obligated to expend state funds first for the general education of the sons and daughters of taxpayers. Comparatively little is left for special investigations which frequently can be carried on only through co-operation with endowed foundations. To raise a barrier against such co-operation is to decline an effective modern means of educational progress. Fortunately boards of regents change, and backward steps may be retraced.

In time the well-meant blunder was revoked, but not until after the expending of many words in ink and oratory. In the Fall of 1925, Dr. Guyer appeared at a public inquiry and was asked a number of questions about the Burgess money and its expenditure, much as Burgess had been interrogated about the Carnegie grant many years earlier.

It then developed that the sum eventually made available for the cancer research was $5,000, that the grant was made in the name of Burgess Laboratories, and that the matter had been discussed with Burgess's "immediate associates, Mr. Weiss, Mr. Schulte, Dr. Schorger, Mr. Storey, and Mr. Mason," and that they were enthusiastic in supporting the move. A suggestion was made that Burgess might be profiting in some way by financing the Guyer experiments, and the question was asked: "Could the results of your research be of any possible use to him in his business or organization?" Dr. Guyer answered, "Not any conceivable use that I can think of. It is a question of heredity, and the connection between heredity and batteries I cannot see." And neither could anyone else.

When listing activities of the Laboratories in 1925, Secretary W. B. Schulte mentioned "Moss" and "Parr Coke Process." The first entry refers to a project for the gathering and processing of Spanish Moss, for which the Burgess Company of Florida was formed in 1925, with headquarters at Wewahitchka, Florida, as related in Chapter 23. "Parr Coke Process" refers to experiments which were conducted for several years to see if good metallurgical coke could be made from Illinois coals; in this connection, Burgess Laboratories in 1925 acquired about 40% of the common stock of Urbana Coke Corporation, Urbana, Illinois. Of these two enterprises, Burgess wrote later, "The Burgess Company of Florida was a venture that did not succeed; practical loss of investment"; and "The Urbana Coke Co., based on inventions of Professor Parr, did not succeed; our investment was forfeited." Then he adds: "Our failures, as well as our successes, have contributed to our business experience. They have been equally valuable. We ought to know what to do and what not to do."

On September 15, 1925, a new signature was entered in the guest book at the Burgess office in Madison; it was the name of Jeanne L. Boué. Madame Boué, a friend of the Boissards, had agreed to take Betty into her home in Paris, there to learn French by the best possible of methods, as a member of a French household. Betty sailed with Madame Boué about October 10, and by October 21 was comfortably settled in her new Parisian home.

Earlier in this informal narrative we have already made known the fact that Betty became the wife of Eric Cotton, and that their romance "started on an ocean liner." The ocean trip referred to was not this one of 1925, but a later voyage in 1927, when Betty sailed for France again, to attend the wedding of a niece of Madame Boué. On reaching Paris she learned that the bride-to-be had changed her mind, and that there would be no wedding. Three thousand miles of traveling for naught! That's how it seemed. But Dan Cupid, who has more than one arrow to his bow, promptly resumed operations; under his spell, Eric and Betty met as passengers, and soon, as recounted in chapter 25, they agreed to sail through life together.

30.

Burgess in Paris 1926 and Burgess Laboratories' Activities 1926-1927

FOR a quarter of a century Charles F. Burgess had been corresponding with men in Europe, some of them leaders in fields of electrochemistry, metallurgy and other branches of science; but he had never crossed the Atlantic, to meet these men in their own interesting and sometimes historical surroundings. Now came the spring of 1926, and with it a feeling that Europe was closer than it used to be. After all, he had a daughter in Paris; and it might be a good idea to learn at first hand how she was living, in a city which had been acclaimed as the heaven of Good Americans. Early in April, his wife got ahead of him. She packed her things and off she went to France, thus setting him a good example. But before he felt justified in taking what was really a well-earned vacation, he sought for other reasons of a more practical nature; so, as the summer approached, Walter Schulte obligingly prepared a list of "Foreign Addresses of Men You can Call On." Burgess got away at the end of June, spent July 4th on an ocean liner, and a few days later was reunited with Betty, to be joyfully greeted by her as "Doctor," in recognition of the degree conferred on him at Wisconsin just two weeks earlier.

Betty had been in Paris for eight months, and part of her routine had been to attend a lecture every Monday morning at the Louvre. She evidently mentioned this fact to her father, with a result now told in her own words:

> The first morning after Dad arrived, he asked me if I would take him to the Louvre, so I mapped out a tour which would cover just the few rooms which I liked so much, and I decided that would be enough for one day.
>
> That "tour" I shall never forget. Dad started out all right, and was most interested in all I showed him. When I thought he had seen enough for one day, I suggested that we go to Notre Dame, have lunch and return home; but there he balked and said he had come to see the Louvre.
>
> We saw it. If what we saw that morning had been put in lecture form, I do believe it would have covered several years of weekly lectures. Not only did we walk miles down all the corridors, through most of the rooms, up and down stairs, but Dad looked in all the cases and at most of the pictures. We ended by his being the guide.

After enduring another hour of Burgessian research, Betty, weary

and hungry, managed to steer her tireless parent to a favorite restaurant on the Left Bank, overlooking Notre Dame. Maybe they could call it a day. But no. Betty continues:

> During the meal he discovered that there was an untold wealth of things for him to see in the vicinity.
>
> I was still game, my feet hadn't yet given out, and after lunch I took him to Notre Dame. Again we visited every nook and corner, although we didn't climb the tower.
>
> When we came out, he saw the spire of the Sainte Chapelle, and announced that he wished to see what that was like. Across the square we went, into the Palais de Justice, through the Conciergerie, and finally to the Sainte Chapelle.
>
> We made a complete tour of the outside of the Palais de Justice, down to the Pont Neuf, back to Notre Dame, around the cathedral—where he saw that there was another island. That we visited, walking down all its streets. Then we crossed the Seine to the Right Bank, and walked down past the Louvre, on to the Rue Rivoli, and all the way down to the Place de la Concorde.
>
> I could go no further, my feet had given out, and I begged to go home. Poor Dad, I think he was ready for more. But he took pity on me, and we rode home. It had been a glorious day, in spite of all the blisters I found when we got home; and it was worth every one of them.

Years later Betty was amazed at her father's "really remarkable memory of all he had seen on that morning's complete tour."

After other interesting experiences in France, including participation in the Bastille Day celebrations of July 14, Dr. Burgess crossed the Channel, and enjoyed some worth-while interviews with scientific and business friends in England. The time available was all too short, and a resolve was made to visit the Old World again as soon as possible.

Then back to America, where a new department was being organized "to utilize the acoustic properties of Balsam-Wool." In a statement made late in 1926, Dr. Burgess said:

> The Laboratories have recently installed a department to investigate the phenomena of sound, and to improve the acoustic properties of auditoriums. This department has during the past year introduced correction of sound in banks, high schools, banquet halls, and theatres.

Balsam-Wool was uniformly successful when used as "woolen underwear for homes"; it was also effective as a noise-absorber; but for this secondary use it had some drawbacks, and no one realized these drawbacks more than Burgess himself. He said several years later:

> One of the first installations of this absorbing blanket was made at the Janesville High School. The walls were draped with these acoustic blankets, but it was not a handsome affair . . . Our first installation soon became a mighty poor-looking job, especially after a few months when the fabric sagged and became laden with soot and dust. Something had to be done with it.

At the Burgess Laboratories, when something had to be done, it was done. R. F. ("Pat") Norris, one of the members of the organization, dis-

covered that a metal facing might be used over the Balsam-Wool without lessening (in fact, slightly increasing) its sound absorbing quality, though only a small percentage of its area was perforated.[268] Such a small area was perforated that the facing appeared to be a continuous surface when used on the ceiling of a room. "We thought Pat was crazy," said one of his friends, "but he was right." In its issue of December 15, 1927, *Iron Age* was able to report:

> Perforated metal tiles, each backed with a 1-inch thick absorbent material, are being produced by the C. F. Burgess Laboratories, Inc., Madison, Wis., for installation on ceilings for the purpose of reducing noise in factories and offices. This new product is known as Burgess Sanacoustic Tile.
>
> Its advantages are that it is non-combustible; dust or dirt can be sponged or scoured off the surface without in any way harming the absorbent effect of the original application; it can be repainted or redecorated indefinitely, without reducing the absorbent factor noticeably; and it can be taken down and salvaged or if desired removed to another location.

Sanacoustic Tile, used not only in factories and offices, but in stores, restaurants, broadcasting studios and other places where the regulation of sound is important, soon became a familiar sight to the American public. People often described it as "some sort of wall-board full of little holes," or argued that "of course it can't be metal, because metal would make the sounds bounce off and add to the noise." Of course they were mistaken; but no harm was done. While misunderstanding the cause, they enjoyed the effect. Sanacoustic Tile reduced din—and increased the fame of Burgess. In later years virtually all perforated sheet metal, especially that used in connection with ceiling ventilation, became familiarly known to the trade as "Burgess metal."

In September 1926, when the acoustic department of the Laboratories was being formed, largely to exploit the sound-absorbing properties of Balsam-Wool, a new man came on the scene. He was Harold R. Berlin, son of a noted American architect. Mr. Berlin, who had been with the Wood Conversion Co., was well acquainted with Balsam-Wool, and knew how to present its merits to architects and others. He was called to the Burgess office in Chicago to develop acoustical sales, particularly of sound-absorbing treatments. The business was successful, especially after the late spring of 1927 when Burgess Laboratories started making and installing Sanacoustic Tile. As early as 1929, however, an important decision was made. Dr. Burgess, who had just returned from New York, came into Berlin's office one afternoon, and announced: "I have made a deal with Johns-Manville to handle Sanacoustic Tile sales, on an exclusive royalty basis."

Berlin "hit the ceiling". Here everything had been going along well, the business had been making tremendous strides, and now the interesting and inspiring work of promoting and selling was to be put into other hands. Burgess was sympathetic, for he understood the younger man's point of view. "Don't be too upset about it," he said. "They want to take over the entire personnel." Berlin insisted that he didn't want to

work for a big corporation. However, he did go to Johns-Manville in New York, to head up their acoustical department, and there he was to stay and flourish for many years, in time becoming a vice-president. Long afterwards, speaking of the transfer of Sanacoustic Tile to Johns-Manville, Mr. Berlin said, "From C. F.'s standpoint it was a logical move for him to make."

It was a logical move also for the Johns-Manville people. They had been installing a fabric type of facing which was perforated, but it had begun to lose its appeal when the Burgess perforated metal facing entered the market. In the latter part of 1928 Burgess Laboratories became a serious competitor, bidding on a big job "right in the Johns-Manville bailiwick," New York City, where the important new Western Union Building was being planned. Western Union engineers visited Madison and showed great interest in Sanacoustic Tile, whereupon the Johns-Manville Corporation also sent representatives, who went right down to Burgess's Florida home with a proposition. One of these men was A. M. Hamblet, an old friend, who had been with the Oxford Paper Co. at Rumford Falls when Burgess spent a summer there many years earlier; the other was Raymond V. Parsons, Johns-Manville consulting engineer. Their visit and further negotiations resulted in the royalty arrangement. Sanacoustic Tile did go into the Western Union Building, but it was supplied by Johns-Manville.

Getting back to 1926, we note that the acoustic department of Burgess Laboratories was earning a good deal of publicity by demonstrating the use of a new device known as the acoustimeter. This device, perfected for the Laboratories by Ralph F. (Pat) Norris,[269] was popularly known as an electric ear. It was an electronic device used for measuring intensity of sound in correcting acoustic properties of rooms, and it was useful in measuring sound-transmission in the sound-proofing of walls.

An early model of the acoustimeter had been tried out on the Madison Rotary Club, whose members sang "I've been working on the railroad" from soft to loud, until they drove the recording needle right off its scale. Then it was used to survey the noise of Chicago's business district, and later on was demonstrated at a meeting of the New York Electrical Society. At this meeting, according to the *Wisconsin State Journal* of April 4, 1929:

> Mr. Norris, with the aid of charts and the mirrored reflections of shadows cast by light rays, explained some of the freaks of sound which make it difficult for audiences to hear. He produced with the aid of phonograph records and amplifiers the traffic din at Sixth Avenue and 34th Street, described as the noisiest place in New York.
>
> The audience, at Mr. Norris's direction, co-operated to provide conversation to keep pace with the din. When the artificial racket was suddenly switched off, the auditorium re-echoed to the clamor of shouting voices.

Demonstrations of "the electric ear" were always good for a sizeable newspaper story, and for an added boost to the name and fame of Burgess.

The sale of the Balsam-Wool development to the Wood Conversion Company, in exchange for some of that company's stock, resulted in a tax headache for Dr. Burgess. The par value of the stock received was $90,000 which the Wisconsin Tax Commission promptly taxed as income. Burgess Laboratories protested, on the ground that the transaction was still highly speculative, that the $90,000 value was merely nominal, that it had been paid to them in exchange for research work on which they had spent $25,000 (charged off as an expense on the books of the company), and that this $25,000 indicated a fair amount to tax as income. The Commission insisted on taxing the hypothetical $90,000, whereupon the Laboratories appealed to the State Circuit Court of Dane County. On February 10th, 1927, the Circuit Court decided against Burgess. This decision was appealed by the Laboratories to the State Supreme Court, which on March 6, 1928 reversed the lower court, and held that the tax should be assessed on a basis of $25,000 only. The victory was a welcome one, but came too late to make much difference in Burgess's attitude toward Wisconsin as an industrial center.

In May 1927 a young man named Jan A. Viljoen joined the staff of Burgess Laboratories. Viljoen, a native of the Transvaal and a recent graduate of Wisconsin, had been with the National Canners' Association as a research bacteriologist. At the Laboratories he was employed as a biochemist. Soon after taking up his new work he devised an efficient method for fermenting molasses to produce butyl alcohol and acetone, thereby substituting the cheap molasses for the considerably more expensive starch contained in cereals. The cereal process had been developed during the early years of World War I by the famed British biochemist and Zionist leader, Dr. Chaim Weizmann.[302] The British government, urgently needing high-grade acetone for munitions, turned for aid to Dr. Weizmann, who promptly started work on the cereal process.[303] His reward was twofold. Offered a title, he declined, asking only "a native home for my people," and receiving in 1917 the Balfour Declaration, which theoretically provided for the establishment of such a home. His financial reward, of unforeseen magnitude, came after the war, when the Commercial Solvents Corporation in the United States arranged for the exclusive use of his patent, on a royalty basis.

The molasses project developed by Viljoen in 1927 was born in less dramatic circumstances. No war was involved, no national homeland, no titles of nobility. It counts, however, as one of the successes of Burgess Laboratories. It definitely avoided the Weizmann patent, and eventually proved its value in dollars and cents. The initial patent application was filed in 1928, a patent issued in 1933,[301] and the process was sold to the Publicker Commercial Alcohol Company of Philadelphia for $150,000.

By this time, however, it had become plain to Burgess that not all problems could be solved in a chemical laboratory. Some of the questions to be answered were human ones, due to normal differences of viewpoint within his organization. He was beginning to realize that some of his younger associates, though knit to him by bonds of loyalty, had definite opinions of their own. Something of this sort must have been passing through his mind in May 1928, when, writing to a friend, he said:

What a strong inclination there is for most of us older people to try to mold the younger ones after our own pattern, rather than help to develop individuality, imagination, and latent qualities not obvious to our more conservative minds!

31.

Burgess Laboratories' Activities 1928

NOW something happened which Doctor Burgess humorously called a fulfilment of prophecy. We have already told how, back in the Eighties, a traveling phrenologist had said, "Don't waste time sending this boy to college—let him be a paper-hanger." "See!" said the doctor in 1928, "I'm not exactly a paper-hanger, but I *can* claim to be in the paper business."

The claim was a good one; it was made as the Burgess Laboratories were launching a new enterprise—the manufacture of stereotype mats for newspapers. These mats, of the "dry" variety, were developed by Dr. A. W. Schorger, one of America's leading experts in cellulose chemistry, and were believed to be unique as to their American origin. Other dry mats then sold in the United States were based on German formulas. Dr. Schorger had studied the mat situation after he joined the Laboratories staff almost eleven years earlier, but had not started experimenting until 1921. The word experimenting is used advisedly; for, as stated by a member of the staff:

> Without any experience in mat production, they tackled the problem. This inexperience proved to be an important factor in their success, since they were not held back by any inhibitions of what "couldn't be done." Nor were they hampered by outworn methods or forced to follow ruts worn smooth by others. They started from scratch with open minds, and with plenty of financial backing, to carry on vast research and experiment.
>
> In their favor were their unexcelled laboratory facilities, together with the years of practical work which they had done along diverse lines of industrial research. Among their technicians were specialists in paper, pulp, and cellulose chemistry. Much of their work involved the use of cellulose, so that the mat problem was a natural line of endeavor.

Dr. Schorger had taken out the first patent in 1925,[270] and the new mat could have been placed on the market at that time, but, as he explained, "We wanted to be satisfied that the Burgess Laboratories had the best mat on the market"; so three more years were spent in rigorous tests, some of them in the plant of the *Journal-Standard* at Freeport, under actual conditions of newspaper routine.

Successful from its start, the mat business was another object-lesson in the value of research and development. It was a tribute also to Dr. Bur-

gess's judgment in choosing associates. In his work as consultant for several paper mills he had learned a good deal about paper making, but he did not make the mistake of thinking that he knew enough. Where specialized work was to be done, he sought the aid of specialists, such as Howard Weiss and Dr. Schorger, who, as already mentioned, had joined him in 1917.

On October 15, 1928, an entry in the Burgess notebook mentions another specialist: "Fishburn arrived to go to work on paper job. Had talk with him; am pleased with his attitude toward work." This refers to Victor E. Fishburn, a practical paper-mill man, who came to manage the plant. Mr. Fishburn recalls that when he appeared in Freeport early Monday morning, October 16, to take up his duties, Dr. Burgess greeted him with "Well, here you are again." "Yes," replied Fishburn, "Here, ready to go to work." Hence the "pleased" entry in the notebook.

In December 1928 the Laboratories were able to advertise that the Burgess dry mat was being used "by many of the country's leading newspapers," and early in 1929 arrangements had to be made for additional manufacturing space. In August 1931, the Burgess Cellulose Company was incorporated to take over the mat business. Another child of Burgess Laboratories had grown to adult stature, and the growth had been accomplished during one of the nation's worst depressions. It had been Dr. Burgess's judgment that a new enterprise could be launched even while business conditions were poor, provided the enterprise was based on quality; and his judgment had been richly vindicated.

In addition to newspaper mats, the Burgess Cellulose Co. was soon making mats capable of reproducing fine screen half-tones, up to 133-lines. The newspaper mats continued to lead in their own field, and in April 1932, as stated in the *Freeport Journal-Standard*:

> The excellent quality of the Burgess mat was attested by the award of the Ayer trophy to the *Hartford* (Conn.) *Courant*, declaring it to be the best-printed paper in the United States. The paper thereupon, in an unsolicited letter, acknowledged the assistance of the Burgess mat in obtaining this award.

In view of the fact that 1,476 newspapers—more than 70% of those published in the United States—entered this contest, the award meant a good deal to the *Courant* and to Burgess.

In the spring of 1928, when he was reasonably sure that the mat business was off to a good start, Burgess looked for new worlds to conquer, and on June 1, the Burgess-Parr Company was formed. This was a reorganization of the Standard Calorimeter Company, of East Moline, Illinois, a concern headed by the venerable Professor Samuel W. Parr, of the University of Illinois, noted gas and fuel engineer. For a number of years Professor Parr had been working with Illium, a highly corrosion-resistant alloy with a nickel-chromium base which he had devised.[271] He also did pioneer work on calorimeters for determining the heat value of fuels; for many years the Parr calorimeter was standard in the industry. Soon after the reorganization of Professor Parr's company, Burgess said:

> I believe that in the two lines of products made by this company, instruments and high-grade alloys, there are large and unlimited opportunities for development. . . . Work is being done on Illium alloys, to give us a better knowledge . . . of its qualities.

The Burgess-Parr Company moved its plant from East Moline to Moline, and later to Freeport. In 1932, after Professor Parr's death, the scientific instrument business of Burgess-Parr was sold to Parr Instrument Company, a new concern organized by his son, H. L. Parr. Burgess-Parr Company continued making Illium castings for the chemical process industries. Illium was to loom large in Dr. Burgess's experiments and in his thoughts throughout the rest of his life.

Big headlines came in December 1928, when Howard F. Weiss of the Burgess Laboratories was granted a patent[272] on a new type of cattle feed. The *Wisconsin State Journal* of December 19 greeted the announcement with enthusiasm:

> PATENTS SAWDUST CATTLE FEED
> CHEMICAL "MIRACLE" EVOLVED HERE
> AFTER TEN YEARS OF RESEARCH WORK
>
> Turning sawdust into cattle feed, like a magician producing candy from a bowl of water, is possible through a chemical process invented by Howard F. Weiss, treasurer of the C. F. Burgess Laboratories, Inc., on which a patent was granted in Washington Tuesday.
>
> Naturally there is nothing in the realm of legerdemain about Mr. Weiss's process. . . . The basic principle of an acid treatment of wood to change cellulose elements of the wood to sugar has been known for many years. . . . But the specific application of this fundamental process to sawdust with the production of a commercial feed in mind is Mr. Weiss's own.
>
> Negotiations with respect to the patent application have been carried on for some time with the Wood Conversion Co., Cloquet, Minn., to whom Mr. Weiss and the Burgess Laboratories assigned the patent. This company will manufacture the cattle feed according to the treating process developed by the Madison chemist.

Popular visions of contented cows dispensing wooden milk at reduced rates were not realized, at least not in America, where conventional food for cattle was fairly cheap. The invention was perfectly valid; it was proved that dairy cows could flourish on a diet based partly on sawdust; but the principal result in the Christmas season of 1928 was a week of picturesque publicity for the Burgess Laboratories.

While all this was going on in America, Eric and Betty Cotton were conducting an interesting experiment in England. In *their* pre-Christmas season they were busy selling a new type of pocket flashlight, the Burgess Snaplite, mentioned earlier in our story. Eric describes this enterprise as "more or less an accident," because it grew out of a remark he made in June 1928, when he was in America for his wedding. During a conversation with Dr. Burgess he had shown an interest in some of the products of the Battery Company, and said he would like to try his hand at selling one of them. "C. F." was delighted with the sug-

gestion, and offered every encouragement. Here was a research project after his own heart—an experiment in export trade, and a test of the ability of his new son-in-law. Soon after the newlyweds returned to England, they received a trial shipment of Snaplites, or rather, of Snaplite parts to be assembled. The trial shipment was not enough; the Snaplites "went like hot cakes" for the Christmas trade, and new supplies were cabled for in haste. Eric's real work was in the shoe business owned by his father; the Snaplites were a sideline, and had to be handled in makeshift fashion at home. So, as told later by Eric and Betty:

> We started the business in a bedroom. We hauled the stuff up through the window, and threw the empties out through the same window. The entire family came in and helped us assemble Snaplites.

Such informal methods were all right at first, but the business launched with Snaplites grew apace, and soon expanded to a point where it was handling and manufacturing other products. Dr. Burgess was proud—proud to think that the initiative had come from his son-in-law, proud to see his daughter "pitch in" and help so effectively in the early stages of the venture. Here was the practice of a virtue he was always preaching—the virtue of teamwork. In a later chapter more will be told about Burgess Products Company, Limited; here we have told the story of its birth, or more correctly of its conception, a happening of 1928.

32.

Burgess Laboratories' Activities 1929-1931

BACK in his teaching days—or rather, back in his university days, for he never really quit teaching—Dr. Burgess was constantly reminding his students of the exploits of practical electro-chemists; and one of his most dramatic examples was the story of Charles Martin Hall. Hall, before he reached the age of 23, invented a process which greatly reduced the cost of aluminum. That was early in 1886. Now, early in 1929, the Burgess Laboratories were engaged in research designed to make aluminum still cheaper. On January 13, the *Wisconsin State Journal* carried a long article with the heading "ALUMINUM PROCESS DEVELOPED BY BURGESS," and the sub-heading, "Burgess Company Builds Test Plant; Hopes to Manufacture Cheap Aluminum Commercially." The project referred to was an investigation, conducted in Madison, of a process invented by a Norwegian chemist, Svend Svendsen. By means of this process, either clay or a low-grade bauxite could be used for the production of alumina, the oxide of aluminum[273]. Burgess Laboratories owned only 20% of this development, which was backed by a group of Chicago capitalists. Encouraging results were noted at a pilot plant set up by the Laboratories, but the work ceased in the fall of 1929, when the other backers, hard hit by the stock crash, were compelled to withdraw. However, nothing undertaken in the name of Burgess was ever a total loss; either the "failure" was credited to experience, or the information gained was later turned to good use. The Svendsen process was not a failure; a number of patents were obtained as a result of the research, and the lessons learned helped the Laboratories greatly some years later in connection with work on a titanium oxide process, as related in our next chapter.

A writer interested in listing Dr. Burgess's accomplishments once asked a member of the family whether he was a musician. The reply was, "Well, the only instrument he ever played was the sweet-potato. He was more interested in muffling noises than in making them." This remark, reminiscent of the sound-absorbing qualities of Sanacoustic Tile, applied equally to another Laboratories development, the "straight-through" silencer or muffler for gas engines, air compressors and the like[274]. Ventilating ducts were silenced in like fash-

ion. This mufflIer, first demonstrated in Madison in 1928, was soon being used by the Studebaker people in their cars, and as a result of the favorable publicity thus gained, it was then adopted by thirteen automobile companies in the United States and England.

Early in December, Dr. Burgess visited the Battery Company's plant at Niagara Falls, Ontario. During his visit he attended a minstrel show, and, characteristically, said good things about it, in a message to the boys who took part. Had he known about the show ahead of time, he might have contributed a solo on the sweet potato!

Christmas 1929 brought greetings from far-off Little America. These came from a former member of the Laboratories' staff, radio expert Malcolm P. Hanson, of the first Byrd Antarctic Expedition. The expedition, like many similar ones, was using Burgess-built equipment, and Dr. Burgess was used to sending and receiving messages through the ether for incredibly long distances. With such far-flung and speedy lines of communication, he could ignore the bonds of time and space. But he was not entirely satisfied. He wanted contact with more people; he wanted to be where more things were happening. Madison had seemed too far from his ideal center of activities, and for fourteen years he had maintained offices in the second largest city in the land. But that was only Chicago! The Mecca of his dreams was further east. So it was that in 1930 he established headquarters in New York, and he and his wife lived there in apartments.

New York did supply some of the contacts he had lacked. It was the official home of many great corporations whose greatness was the result of scientific achievement; it was the home also of several scientific bodies of which he was a member; at the Chemists' Club on Forty-First Street he could be sure of meeting, on any day of the week, a host of kindred spirits, old and young. Some of his former students and faculty colleagues, now leaders in science and industry, were living in or near New York, a circumstance which led to many pleasant reunions. One of these was with his old friend Murray C. Beebe '97, who was head of an important industrial laboratory in Connecticut. The two men talked for hours about Wisconsin and their "bicycle spelter" days.

One day in the winter of 1930-31, Dr. and Mrs. Burgess invited Mr. and Mrs. Beebe over to New York to go with them and see *The Green Pastures,* then at the height of its opening run. At dinner that evening it was noted that the Beebes were vegetarians. Dr. Burgess, interested in everything under the sun—especially in departures from common practice—began asking questions. He said, "I'd like to know about the way you live." "Don't tell him anything about it," interposed Mrs. Burgess; "I don't want to be bothered with it." Then all four of them laughed, none more heartily than Charles. He knew that Ida was right, that he was inclined to start more personal researches than any one man could carry through, and that no amount of scientific rightness would make a Beebe diet suit a Burgess. He did like vegetables, but he also liked meat, and he seldom ate one without the

other. One of his favorite restaurants was the Red Star Inn, on North Clark Street in Chicago, where if his order was not for corned beef and cabbage it was usually for pork shanks and sauer kraut.

Developed by the Laboratories at about this time was a new etherified cellulose product to which was given the trade name of "Glycel." This product, resulting from the work of Dr. Schorger,[275] could be coagulated so as to form filaments or thin flexible sheets of "Glyfilm," a strong, tough material resembling cellophane. Patents covering the process and products were sold to the Carbide & Carbon Chemicals Corporation, a subsidiary of the Union Carbide & Carbon Corporation.

In December 1930, when Dr. Burgess wrote his customary year-end story for the newspapers, he confessed that he could not write it "with unrestrained enthusiasm." Of this story he said:

> To be truthful, it must report a 20 percent shrinkage in sales over 1929, a somewhat smaller though distinct shrinkage in employment, and ineffective effort to maintain things at the old standards.
>
> This is stated not as a wail or a lament, only a commonplace statement of fact. We have, indeed, much for which to give thanks. That branch of our business devoted to the manufacture of stereotype mats, a paper product, has been running at full capacity night and day for the past ten months, with a fair prospect of increasing this capacity next year.

One of the most fortunate research projects in Burgess's career, was the one which put him in "the paper business."

In January 1931 word came from Tokyo that Fusanobu (Paul) Isobe was coming to America to be present at the dedication of the new chemistry building at Indiana University, and to receive the honorary degree of Doctor of Laws. He also wanted to discuss sources of supply of graphite, and to consult Dr. Burgess about the advisability of purchasing a nitrogen-fixation process from the DuPont interests. They met in Chicago. Doctor Isobe dined with Doctor Burgess, who treated him like a son and gave a wealth of fatherly advice and encouragement, as one result of which he purchased certain patent rights from the DuPonts. At this time Burgess was 58, Isobe 47. After this reunion, in March 1931, they never met again. Their bond was one of mutual respect, and mutual belief in research and development.

At about this time the Burgess Laboratories developed a power-driven window-ventilating device,[276] to filter out dust, and deliver a supply of clean, fresh, quiet air. This ventilator, manufactured by the Battery Company, was called the Mountainaire. "Quiet air," referred not only to the device's almost silent operation, but to the fact that it absorbed street noises, an important consideration in noisy localities such as Chicago's "Loop." Both types of quietness were rare in the ventilating devices of 1931. The Mountainaire was of particular interest to Burgess because it removed a very large percentage of air-borne pollen, and he was a sufferer from hay-fever.

The Mountainaire, which did get on the market, received a fair

amount of publicity, but not nearly as much as the "floating brick," which did not. The brick in question had been a Burgess Laboratories project for several years. The work had been started for the American Face Brick Research Corporation. Developed under the direction of Howard F. Weiss, the brick was made from certain clays normally used for making brick. The process which was developed[277] was based on the discovery that a desirable porous brick could be produced from clays that "bloated" when fired in a brick-making kiln. Thus the bloating tendency which was a headache for the brickmaker was turned into a virtue. The cause of the action was determined and then synthetic bloating clays were made from a large variety of clays. The porous finished product could be made to vary from 20 to 60 pounds per cubic foot as required. The lighter weights were recommended for insulation, the heavier ones for heavy structural needs. The brick was a good heat insulator, and because the pores consisted of a mass of small water-tight compartments having thin walls of water-resistant vitrified clay which defied the passage of water, it floated. In his January 1932 speech accepting the Perkin Medal,[33] already referred to, Dr. Burgess happened to mention that one of the products of Burgess Laboratories was a light-weight brick, strong enough to build a tower "five times the height of the Empire State Building." When (41 years after Ivory Soap), he added, "It floats," the fun began. The dozing news reporters came to life. Their readers might not know much about electrochemistry, but everybody understands a brick. And one that floats! Within a few days the "Burgess floating brick" had received mention in newspapers throughout the land; and Dr. Burgess was bombarded with letters of inquiry from architects, builders, homeowners, and plain curiosity-seekers. Though production was postponed indefinitely, for economic and wartime reasons, the floating brick episode remains as an example of public interest in a simple thing.

Not quite so simple, but of similar human interest, was a device described in a *Milwaukee Journal* story on March 28, 1932, which ran in part as follows:

> Light now comes in package form. The Burgess Battery Co., with Madison as headquarters, has made the miraculous and mysterious electric eye almost a household utensil. . . . Its simplest application is the control of electric lighting systems, whereby lights are turned on at nightfall and off at daybreak by purely automatic means.
>
> The complete simplicity, ruggedness and reliability of these latest light-control units, Burgess officials claim, bring light-control possibilities into the realm of everyday life.
>
> The household application of the electric eye, it is stated, has long been delayed by the intricacy and delicate nature of the usual forms of photo-electric cells and their circuits. It remained for British technicians to develop an entirely new conception of light-sensitive cells, which has been applied to many practical uses in Great Britain and Germany.
>
> Recently the cell was introduced into this country as the Burgess radiovisor bridge, and American engineers have evolved complete alternating and direct current light relay units.

In 1931, when the business of all battery manufacturers was falling off, it became necessary to find work for the Burgess Battery Co. in other fields, so that the plant might be kept running profitably. Then, in the words of Dr. Burgess:

> We believed that the "electric eye," an electronic device, was destined to play a big part in the industrial world, and that our company should therefore get started in this field. We did make a start by organizing the Electronic Division of Burgess Laboratories.

Dr. Burgess then made a contract with a British concern, Radiovisor Foreign and Colonial, Limited, for United States rights under its selenium light-sensitive cell patents. These rights were covered by a license to the Burgess Battery Co., as that company was to do the manufacturing and selling of equipment and apparatus employing the light-sensitive cells obtained abroad. Because of what Dr. Burgess called "a complication of business and other factors," including some misrepresentations, no real progress was made. The British company derived its rights from another concern, Radiovisor Parent, Limited, of England, and ere long the two companies were engaged in a lawsuit, the junior company charging the senior with misrepresenting the scope of the original foreign license on the selenium light bridge. The claim against the parent company was for £200,000 and the return of 120,000 £1 shares. In an atmosphere of this sort, it was hardly to be expected that Burgess Battery Co., an innocent third party, would feel very secure in the promotion of the electric eye business. As a matter of fact, grave obstacles were being encountered in the United States, where it developed that several powerful corporations already controlled rights which seemed to nullify those implied by the Radiovisor license.

Against this background of complications, Dr. Burgess was invited over to London, to serve as an expert witness in the legal battle of the two Radiovisor companies. He went. He went willingly, not to say eagerly. His presence had been asked by the defendants, though, as a matter of fact, the testimony he would be able to give would be damaging to them. But in the trial he saw an opportunity to help the Burgess Battery Co. by securing more liberal interpretation of certain clauses in their Radiovisor contract; these clauses had been construed by the licensor in a manner which he considered arbitrary, and now a chance might come to gain relief.

The suit was tried in May 1932, at the historic Law Courts in the Strand. One who was present now recalls the scene:

> There was C. F. standing cool, calm and collected, in the very severe atmosphere of a half-lighted court.
>
> He might have been rattled under that cross-examination, but he was not.
>
> Facing him was one of the most famous King's Counsel in England, Sir William Jowitt. Chief Counsel for the defendants was Sir Stafford Cripps.

> I said to him, "I wouldn't have been on that stand, before those advocates, for anything." He said *he* was not feeling very comfortable. But he did not show it.

A transcript of the proceedings is not available; it would serve as a souvenir of a colorful episode in a colorful career. The encounter with Sir Stafford Cripps, who had only recently been knighted, was one of the high-lights of Dr. Burgess's memories. Cripps had worked hard, and hence deserved respect. His hard work made him the greatest authority on corporation law in Britain, and he once told a political audience that he received "fabulous and fantastic sums" from the ruling classes "to get them out of their difficulties." A member of the ruling class not aided by him in the present case was John George Stewart-Murray, Eighth Duke of Atholl, Chairman of the plaintiff company, Radiovisor Foreign and Colonial, Limited. Dr. Burgess met the Duke, and, reports a friend, "the two did not get along very well together." Be that as it may, the contacts made during "The Case of the Electric Eye" were interesting ones, and a touch of Chaucerian romance is suggested by the coming together, in London's ancient Strand, of a Knight and a King's Counsel, a Duke and a Burgess.

33.

Burgess Laboratories' Activities 1932-1935

DR. BURGESS was content to charge the Radiovisor episode off to experience; or it might be more accurate to say that he *credited* it to experience; that is the implication of a statement he made about it sometime afterwards, explaining the essentially constructive value of research, regardless of immediate results:

> Out of this experience we became impressed with the possible usefulness in many fields of a miniature, snap-acting switch; one that could be made to act with minimum power, free from vibration difficulty, capable of being operated in any position. Such a switch was evolved in our New York laboratories.

The new switch was related to the Radiovisor only on what might be called a one-thing-leads-to-another basis. Hugh Terrell, who made the Radiovisor contract with Dr. Burgess, showed him also a small vacuum switch made in Germany. Dr. Burgess arranged to sell this switch in the United States, and for a while the Laboratories did sell the device in considerable numbers. When patent and other difficulties arose, the business was dropped, but in the meantime Burgess had become interested in the "miniature self-acting switch." Work on this was started in 1932,[256] and in 1933 it was put on the market as the Burgess "Micro-Switch." Four years later it was transferred to a newly-formed concern, the Micro-Switch Corporation, whose volume of business increased steadily and during World War II reached several million dollars a year.

Another development was a synthetic base-exchange material used for softening water. This material, Burgess Zeolite, was manufactured by a novel process. Other companies had used heat to remove the water during the final stage of manufacture; the Burgess Laboratories used a freezing process. In making a zeolite of this kind it is necessary first to make a jelly or "gel" containing much water; this then has to be hardened by removing a large part of the water, and the result is a hard mineral-like product. Dr. Schorger found that by freezing the gel it was possible to harden it and remove the water in the form of ice. The product equalled or surpassed that produced by the heating process. The Laboratories had a lively patent dispute with the

Permutit Company, who dominated the field, but eventually a patent was awarded covering the freezing process.[278] Ere long the zeolite plant was operating 24 hours a day, and eventually the product was taken over by the Research Products Corporation in Madison.

In 1932 also the ingenious "Pat" Norris perfected the Burgess Multiple Outlet,[279] a continuous electric conduit to fit at the top of the baseboard and provide outlets at frequent intervals for lights or fixtures throughout the house. At first manufactured in the Burgess Madison plant, this development was later purchased by the National Electric Products Corporation, of Pittsburgh.

In New York a branch of Burgess Laboratories had been established, and in 1932 Jackson Burgess was there in charge, a fact mentioned with some pride by Dr. Burgess in one of his letters to Carl Hambuechen.

In September 1932, Dr. Burgess became a director of the Crocker-Wheeler Electric Manufacturing Company, of which concern he had been a stockholder for about a year. He had watched the progress of this company for many years, for it had been founded by one of his friends of the early days of the American Electrochemical Society, Dr. F. B. Crocker, long-time Professor of Electrical Engineering at Columbia. Dr. Crocker had died in 1921, but Burgess's personal interest had been sustained by the fact that another friend, with a similar background, had become associated with the company. This was Dr. Edw. R. Berry, who had previously been with the General Electric Company for many years. Burgess had been well acquainted with motors and dynamos built by Crocker-Wheeler since his earliest days at Wisconsin.

It should be noted that all these activities occurred in the depth of a financial depression. But Burgess did not depress easily, even when, on the advice of his brother George, he gave up his cherished New York laboratory. This was early in 1933. In March, writing from his Florida island, and presumably referring to the sudden closing of all banks at the start of the Roosevelt administration, he said:

> Say! This is an interesting situation—me on a barren island and stranded without money.
>
> A new deal is evidently started—perhaps we shall draw good hands—anyway, plenty of excitement.

Excitement there was, and many irritating problems to solve, but later in the year, addressing the Freeport Rotary Club, Burgess seemed ready to welcome new excitement and new problems, for he said:

> We are praying for some new revelation of nature's secrets which will create new industries, just as the radio, the automobile, the phonograph, the airplane were created.
>
> It may come through television, through a pocket device by which each individual can at all times be kept in touch with events the world around, or through the smashing of the atom, thus releasing the vast store of mythical energy which the atom is supposed to possess.

In October 1933, Dr. Burgess visited Milwaukee, there to be guest of honor at the 25th anniversary meeting of the founding of the Milwaukee section of the American Chemical Society. He wrote about it to Carl Hambuechen, mentioning that both of them had been present at the original meeting. The choice of a special guest for the anniversary was no mere chance; Dr. Burgess was an old acquaintance of the Milwaukee group, and in its early days a friend in need. Frank S. Low, of the Westvaco Chlorine Products Company, New York, a former member in Milwaukee, recalls some of the circumstances:

> We could not afford high-priced speakers, and could not invite speakers from great distances, because they had to have their expenses paid. Dr. Burgess had just published his first work on electrolytic iron. We called him in, and he addressed us. He came several times. He was gracious. No one ever called on him for help in vain.

Meanwhile Burgess Laboratories continued, as usual, to develop new products. An inventor named Germonprez[280] had conceived the idea of using the Sanacoustic perforated metal ceiling as a ventilating device, and had intended the air to pass also through the sound-absorbing material used within the tile. Burgess Laboratories purchased the invention, and although the passage of air through the absorbent material was found not to be practical, excellent air distribution was accomplished through the perforated metal alone,[281] and the system, known as Multivent, was first used in railroad cars, permitting air-conditioning without drafts. Another modification of the Germonprez invention by the Burgess experts did make ventilating possible even where sound-absorbent material is used.[282] In this system, known as Acoustivent, the air passes not through the sound-absorbent pads, but around them, through specially constructed air-ducts. Multivent and Acoustivent were eventually turned over to the Burgess-Manning Company. Multivent is made and sold by Pyle-National Company; Acoustivent is sold and installed by the contractors installing the perforated metal acoustic treatment.

The Burgess Titanium Company, incorporated in January 1935, developed a new process[283] for the manufacture of titanium oxide, a paint pigment. This process, an outgrowth of work done earlier with the late Svend Svendsen and continued by Burgess Laboratories, resulted in the production of a brilliant white paint pigment. In forming the new company, deposits of titanium ore in Virginia were acquired from Professor C. K. Leith, internationally known geologist, one of Burgess's friends from his University days. Dr. Leith, of the class of '97, had for many years been Professor of Geology at Wisconsin. He joined forces with Burgess Laboratories in forming the Burgess Titanium Company, the Laboratories contributing the development work on the process, and Leith putting in the right to his titanium ore deposits. The process—indeed the whole enterprise—was later sold to the Sherwin-Williams Company.

In its issue of October 24, 1935, the *Wisconsin State Journal* carried a story headed "Burgess Quits Presidency of Laboratories." A heading in the *Capital Times* also used the words "Burgess Quits." "Quits" is a headline word, used to save space; if Burgess was quitting, it was only in a limited sense. The official announcement was worded as follows:

> C. F. Burgess Laboratories, Inc. takes pleasure in announcing that marking the close of twenty-five years of its corporate existence, the office of Chairman of the Board has been created, that C. F. Burgess has been elected to this office, and that Arba B. Marvin, of New York, has been elected President.
>
> Mr. Marvin, as a participant in the organization of the Laboratories, and as its attorney for more than twenty years, is thoroughly familiar with the Laboratories' purpose of doing scientific research on a commercial basis.
>
> November 1, 1935 Madison, Wisconsin

The twenty-fifth anniversary of the incorporation, and the assumption by Dr. Burgess of his newly-created office, seemed to deserve some sort of celebration. On Friday, November 30, the occasion was honored by a dinner at the Loraine Hotel in Madison. Present were 150 friends of Dr. Burgess, many of them employees, and others from business, scientific and university circles. Vice-President Howard F. Weiss served as toastmaster. Speakers included such old friends as Carl Hambuechen, James Aston and Arba Marvin, Professors Louis Kahlenberg and O. L. Kowalke, and Dean E. A. Birge of the University of Wisconsin. Professor Kahlenberg declared that the reason for Dr. Burgess's success was his ability to see the possibilities in unimportant discoveries—"That is the rare ability that makes success, and which so many of our industrial leaders lack." Dean Birge spoke of the Burgess devotion to the cause of research. He said, in part:

> Systematic research did not start in American universities until about 1870, and look what it has done to date. Men in research have been accused of making too much progress because they are making so many products that they are preventing people from buying the things that are available because they do not have the money. It is a foolish charge. What we are having now are the growing pains of rapidly expanding industry. We will come out of them, and research will progress faster than ever.

Burgess, characteristically, directed his remarks toward the future, and spoke of what might be expected in "the next twenty-five years," a period extending to 1960. He outlined three definite projects which research was seeking to develop:

> A trend toward the betterment of homes is in full swing at present, but it will take the next tweny-five years to produce the home which will really be wanted.
>
> The second of these projects is the control of noise, and the third is the control of the weather. Already we have developed air-conditioning for our homes, but our work will not stop until we can control the weather as it affects our crops.

Greetings by the score were received from friends near and far. Kenneth Burgess, unable to be present because of injuries received in an automobile accident, telegraphed to his brother George who had come on from New York:

> Please congratulate Charles on the Silver Anniversary of the founding of the Laboratory which has contributed in such large degree to the honor and distinction of the Burgess family in our generation. As the most crippled and infirm member, I salute him as the head of the clan, and you as an able and worthy associate.
>
> Kenneth F. Burgess

A touching tribute came from Vroman Mason, who had retired to California for his health. This loyal friend and colleague spoke from his heart:

> It has been a wonderful quarter of a century to look back upon, and you have accomplished much since you "left the University and went to work."
>
> You have not only succeeded and prospered yourself, but you have brought prosperity to your associates and the thousands of people you have employed.
>
> As one of your associates, I'm sure you know of my gratitude and appreciation. I hope the next twenty-five years will be happy and successful ones.

34.

Burgess Laboratories' Activities 1936-1942

EARLY in 1936, Burgess attended a dinner in New York in honor of one of his electrochemical heroes, Charles Martin Hall, "Father of Cheap Aluminum." This was the fiftieth anniversary of the first production of aluminum by Hall, and the twenty-fifth anniversary of the Perkin Medal award to him for that achievement. Hall and Burgess had often met in the early days of The Electrochemical Society. Hall had died in 1914, aged only 51. Burgess, now 64, had still a span of useful years ahead. Although, as we have seen, he had "quit" as president of Burgess Laboratories, he was still chairman of its board, and in its affairs he was still the dominating influence.

Burgess's domination was not of the brow-beating type; it was based on his belief that he was right; and this belief in turn was usually the result of study and research. Be that as it may, his associates reserved the right to disagree with him. He would not have had it otherwise; he had no use for yes-men. And when he was opposed by members of his own group—men who were unquestionably loyal—he sometimes healed the breach by widening it. An example of this paradox is seen in the case of Walter B. Schulte and the Micro Switch Corporation. When Walter Schulte started working for Burgess Laboratories in 1911, he was 23 and Burgess was 38. The fifteen years difference was more important then than it became in later years. By, let us say, 1937, Schulte was no longer a young chemical engineer just reporting for work. He had long been an official of the Laboratories and the Battery Company; he was rich not only in technical but in business experience. In his relationship to Burgess he was no longer a disciple but an associate. Having gone through this process, a process experienced by many others in the organization, Mr. Schulte was qualified to form his own judgment, and sometimes his judgment in business matters differed from that of Burgess. Schulte and Burgess had several differences of opinion as to how the business of the Burgess companies should be handled, and in 1937 Burgess devised a plan whereby he could have his own way, and Schulte could have his, and both of them be happy. An arrangement was made by which Schulte, in exchange for a considerable portion of his Burgess stock, took over the Electronic Division of the Laboratories, and formed the Micro

Switch Corporation. As noted before, the plan worked very well. Under Walter B. Schulte the Micro Switch Corporation grew and flourished, a credit to its parent organization.

Similiar in some respects, though not in all, was the case of another new corporation, formed in the summer of 1938, and headed by Howard F. Weiss. C. F. and Weiss also had occasional differences on ways of doing business, and also, as in the case just mentioned, found a way to get together by separating. That is the origin of the Research Products Corporation; that and other important factors. For one thing, Howard Weiss and several others of the Laboratories staff preferred staying in Madison even if it might mean severing relations with the Burgess companies. These persons included Benjamin S. Reynolds, Kemper Slidell, Max Kliefoth and Miss Bertha Weisman.

Some of the changes made at this time resulted from the tax situation. Although many taxing authorities held that expenditures for research were *investments,* Burgess Laboratories had always taken the view that they were *current expenses.* Burgess Laboratories, newly classed as a holding company, was liable to taxes that would plainly be prohibitive. Excessively high surtaxes imposed upon undistributed profits now placed the business in such jeopardy that it was forced in 1938 to discontinue entirely its activities as a research organization. Here was another change in the established practices of the Laboratories which hastened the time of separation. Some of the results of Laboratories research in the field of water treatment and certain filter projects were turned over to Mr. Weiss and his associates, the Laboratories taking preferred stock in the new concern as part payment. In August 1938 Burgess wrote to a friend:

> Weiss and some of the other local people are contemplating the organization of another laboratory, and while not using the Burgess name are figuring on taking over some of the Laboratories' developments.
>
> These plans and changes are being carried out in a most friendly and cooperative spirit.

The *Capital Times* announced the formation of Research Products Corporation, with Howard F. Weiss as President, and quoted him as referring to "the good work initiated by the Burgess Laboratories," and pointing out that "over 1,000 people have jobs as the result of the new ideas created and developed by the Laboratories." In personnel, locale and products, the new concern was definitely of Burgess origin. Its officials were from the Laboratories, its home was the former Burgess plant on East Washington Avenue, Madison, and it took over the water-treatment division of the Laboratories and certain air-filter business. This separation was a step towards simplification of the Laboratories' structure—to Burgess a matter of great importance—and a means of insuring harmony. It also gave the privilege of carrying on their own business in their own way to a group of men recognized by Burgess as having fairly earned their independence.

In the August 1938 letter just referred to, Burgess also wrote:

C. F. Burgess and A. B. Marvin—about 1936

> Pat Norris has shown excellent enterprise and good business judgment in launching his Norris Industries. He has a product in which he believes enthusiastically. . . . We are all hoping that his venture will be a success.

R. F. Norris had taken over some small items from the Laboratories, but he was also prepared to work on important projects of his own. An expert in acoustics, he also conducted a consulting business in that field. Again quoting from Burgess's letter, the situation is described as follows:

> I think you understand quite fully the actual status of our activities, and you will realize that the steps being taken are fully in accord with my wishes and purposes, which are to cooperate with the members of our organization in establishing themselves in businesses of their own and capitalizing on their many years of experience with the parent company.

While all this was going on, the Burgess Laboratories was moving entirely out of Wisconsin. In 1926, as already stated, the corporation had transferred its legal domicile to Delaware; now in 1938 it took the further step of giving up its license to do business in Wisconsin. To some observers this seemed like the beginning of the end.

When Winston Churchill, in one of the great moments of history, remarked that he had not become Prime Minister in order to "preside over the liquidation of the British Empire," he echoed the spirit of a similiar statement made earlier by Charles F. Burgess regarding a report that the business of the Laboratories was being wound up. On July 6, 1940, Burgess had this to say:

> Having been directing head of the C. F. Burgess Laboratories, Inc., since its beginning in 1910, I am in a position to know and to state that at no time has there been adopted or in effect any plan for the liquidation of this organization.

Then came a sturdy pledge of confidence, a vision of achievements yet to come:

> My chief property interest has been and is now my shares of stock in the C. F. Burgess Laboratories, Inc., of which I own slightly over half of the total shares outstanding. This company has been notably successful in profitable operation and in accomplishing its objectives of doing industrial research and development work. It is my hope and intention that this commission shall continue, and even to a greater extent than in the past.

The research here mentioned, which had been abandoned in 1938 except for some work done by Burgess himself at his own expense, was industrial, but by the fall of 1941 the Laboratories undertook another type of research, a project of importance to the nation. Two months before Pearl Harbor, the *Daily Courier-News* of Elgin, Illinois, announced that the Burgess Laboratories had leased a building at Elgin, to be occupied at first by a small staff of chemists, and used as a special research laboratory. As to the purpose of this sudden move, hardly anything was said. Hardly

anything could be said, for wartime secrets were involved, and secrets could be guarded best with silence. The confidential work was continued for over two years, and, for the second time in a quarter-century, Burgess saw his Laboratories making a highly specialized contribution to the cause of national defense. Activities of this type, including work on such projects as batteries for the "proximity fuse", then one of the Government's top secrets, were undertaken without profit; the Government paying actual expenses only. The Laboratories really contributed much more than was apparent, for no charge at all was made for the services of the top officers, including Dr. Burgess. This was the Laboratories' contribution to the war effort, approved heartily by all the stockholders.

Among several non-military studies pursued in Chicago at about this time was one concerning "controlled corrosion," or the machining of metals through the medium of chemistry and electricity, rather than by tooling with other metals. This was known as the Burgess "Electrolick" process. The name Electrolick was suggested by Mr. George Heise, of Cleveland, Ohio, after someone had remarked that a process of electrolytic polishing resembled the action of a small boy licking a lollypop smooth. Electrolick was adapted not only to polishing, but to drilling (square holes as easily as round ones!), cutting, filing, and turning. Dr. Burgess demonstrated the process early in October 1941 at a Chicago meeting of The Electrochemical Society. In his demonstrations he pointed out that in the ordinary methods for removing metals, as in a lathe or drill press, much energy is used and the metal is torn to pieces; whereas in his "Electrolick" process the action is *gradual,* and the metal is not subjected to stresses. He stated proudly that all he needed was the right dry battery to enable him to drill holes readily in the hardest metals which it was impossible to do with ordinary metal-working tools. He wrote an amusing story about the possibilities of Electrolick,[55] and distributed it in pamphlet form during the demonstrations at the Electrochemical Society's meeting. The pamphlet earned wide interest, and resulted in a considerable volume of "fan mail." After the meeting Burgess wrote to a friend explaining how, if given enough time, Electrolick could be used to drill through a thick sheet of metal. Then he added:

> Perhaps you will think that I am playing too strongly into the hands of the bank-robbing fraternity; but as long as we have to lose our money through some agency, why be too particular?

He could not resist the opportunity to take a dig at the policies and practices of the New Deal. It was good, clean fun. Rarely a day went by without a smile. Rarely a day. And yet, on October 23, just two weeks after his little joke about the bank-robbers, Burgess was feeling definitely blue. Something had gone wrong; either some big thing, such as the strike in Freeport, then ten days old, or just as likely, a lot of irritating little things. It should be remembered that through all these exciting days he was drawing heavily on his reserves of energy. He would appear at his office ahead of other people in the morning, and stay there till long after the others left at night. He tired out some of the younger

men. But on October 23 there seemed to descend on him a shadow of discouragement; and late that evening, in the pages of his faithful diary, he attempted to put the shadow into words:

> No one seems to want to take advice from me—even if it is good advice. I am getting to be an isolationist, even if I would like to work with people. Lawson, Mrgudich, Dan, Reynolds, Schorger, Fishburn—resent me in various degrees, and sometimes I feel that Jack resents my domination.
>
> I know this—that a pat on the back—even to an old guy—is appreciated, and that advice is less and less appreciated, even when prompted by unselfish motives.
>
> I feel at the end of this day like a lone wolf. Gee, how I wish someone would pat my old back.

Such words, the lament of a strong man weary from overwork, seem to call for sympathy; indeed, they invite sympathy. But they are the closing words of a page; and as we turn to the next page we read:

> I'll take that all back. It was a temporary aberration. I am as young as I ever was. Am willing to work for research 5 years, 10 years, even 50 years in future. Why, I am planting cajeput trees—over 5000 of them—I hope to see them grow—mature—make lumber—from which I can make useful products.
>
> Here I am, trying to preserve timber against teredo attack—twenty years will make me 88 years old—but I hope to see results beneficial to future generations. What fun there is in this—lots of it!

35.

Burgess Island 1924-1930—Short Wave Radio Development

"GUESS what I did down in Florida." It was early in 1924, and Burgess, just returned to Chicago, addressed his remark to Duncan Keith. Keith promptly replied, "My first guess is that you have bought an island." "Right, the first time," said Burgess. Then, with the zeal of a man who has bought an island and feels slightly on the defensive, he launched into the tale of his romantic new domain.

It really was romantic. "Little Bokeelia," in Charlotte Harbor, "well down on the west coast of Florida," was a genuine tropical island, possibly an old resort of pirates. Its very name suggested pirate speech; "Bokeelia was a mere re-spelling of the Spanish *Boquilla* or "little mouth," which distinguished the place from *Bocagrande,* or "big mouth," eight miles away. On nearby Pine Island was the relatively populous *village* of Bokeelia, hence the "Little" in the name of what soon became known as Burgess Isle.

Burgess's motives in taking this new step were doubtless mixed. Foremost perhaps was the matter of his wife's health, which called for mild winters not found in Wisconsin or Illinois. Then there was the opportunity to indulge in certain types of research without constant interruptions from visitors or telephone. And not without its influence was the ambition, untold in words but shared by every man, to feel the thrill of being monarch of all he surveys. An island is essentially an empire.

Purchase of the island, from his Chicago friend DeWitt C. Harris, was arranged in the middle of February 1924. Harris, whose Florida home was on Pine Island, had told him about Little Bokeelia, and took him down to inspect the place. Even before taking possession, Burgess was busily engaged in research, as indicated by a letter to Mr. Harris, written from Madison on February 24th:

> In the hurry of leaving the other day, I overlooked packing a small parcel containing those cabbage-palm fibers which I wrapped up in newspaper. I shall appreciate it if you will mail this to me, and I would also like to have about a two-foot section of cabbage-palm trunk for further study. I should be glad to pay the expenses involved in the collection of this sample, and its shipment to Madison.
>
> I brought with me a small package of Spanish moss, on which I will make some tests, but I ought to have a larger amount,

> say 20 pounds of the green material, and if you can conveniently send this to me when you make your trip of investigation, I would like to have it.

Friends and acquaintances received letters throughout 1924 describing the newly acquired property and its attractions. One of these letters advised that the recipient study the map of Florida, and continued:

> You will see that there is an island called Pine Island, which is about twenty miles long and several miles wide, and at the north end is a small island which I have acquired.
>
> This is about 200 acres in extent, although most of it is a low mangrove thicket over which the high tides flow.
>
> There are perhaps 30 or 40 acres of high land, built up by prehistoric races in the form of shell mounds, and on this part of the island is a grapefruit orchard, which has gotten into a bad state by long-continued neglect.
>
> The island is one of the most attractive on the west coast, on account of the possibilities of development, and it is in the center of a district which is rapidly being taken up, mainly by northern people.
>
> It is right in the greatest tarpon-fishing district of Florida. The island known as Useppa on which is a large hotel and Tarpon Inn is a few miles away. Fishing and game are abundant, and the bay between my island and Pine Island is a famous hunting and fishing section.

Burgess himself was not especially interested in hunting and fishing, but he was not going to leave out any good talking points. His main interest was suggested by his reference to the island's "possibilities of development." Such possibilities he saw everywhere, but the island was to provide him with new fields of research, and for some of these he had high and glowing hopes.

Freedom from telephone interruption was going to be a boon. But some means of communication with the outer world would be desirable; and it did not take long to decide that the best means would be radio. In November 1924, a young radio operator named Donald H. Mix was visiting Madison, as the guest of W. H. Hoffman, of the Burgess radio laboratory there. Mix, only about twenty years old, had been with one of MacMillan's expeditions, and in November 1923 he had radioed from North Greenland, notifying W. B. Schulte about the good performance of the expedition's Burgess batteries.[287] Many of the Greenland Eskimos first learned of the importance of batteries from Commander MacMillan; and when he compiled an "Aid to Conversation" in the Eskimo language, one of his special phrases was "Batterit khano-e-lung-e-lat?", meaning "Your batteries—are they in good order?". Don Mix's radiogram was a pleasing answer to this often-asked question.

During Mix's visit to Madison, Mr. Schulte told him about the plan to set up a short-wave station on the island, and Mix became interested. About the middle of December, Burgess wrote to him, describing the island, and then said:

> We are arranging as a laboratory project to install a radio station under an amateur license, which station is to operate in

> conjunction with our station here in Madison. Communication is to be established, and also both stations are to keep in touch with as many of the amateur stations throughout the country as possible.
>
> The duties which we have in mind for yourself or other radio expert who may take this job, would be to first come to Madison, and in conjunction with Mr. Schulte and Mr. Hoffman, work out the plans and then go down to Florida to supervise the installation of the equipment, and then to operate it.

That is how Donald Mix, long a leader in American radio relay circles, became connected for a while with Burgess broadcasting activities.

The wireless "hams", who built and operated their own shortwave transmitters, aiding greatly the development of American radio, were well aware of the role played by Burgess Laboratories in that development. They were familiar with the internationally known call letters of the Burgess station in Madison, 9EK-9XH; and after 1925 they also became acquainted with station 4DM, on Burgess Isle. They followed with interest the steps taken to establish two-way communication between Madison and the island, and the interesting developments that followed. These developments were important. Seeking to improve the quality of their broadcasts between Wisconsin and Florida, several of the Burgess radio experts, W. H. Hoffman, Donald H. Mix, F. H. Schnell and Phil Zurian, worked on the low-power shortwave system so that by November 1925[294] they had developed a transmitter of increased efficiency with a quartz crystal wave-length control.[295] In a paper published in one of the radio magazines,[296] Phil Zurian is given credit for devising a light-weight transmitter capable of establishing communication over almost incredible distances, with power "less than that used by a vest-pocket flashlight." Small battery-powered transmitters and receivers were designed, some of them custom-built for use in scientific expeditions headed by MacMillan, Byrd, Wilkins and other noted explorers. Most of these expeditions were in the North and South Polar regions.

In the spring of 1926, Sir Hubert Wilkins (then Capt. G. H. Wilkins), making his first flight from an American base to the arctic regions, used transmitting and receiving equipment designed, built and tested at Burgess Laboratories. This outfit was needed in a great hurry, and the work on it was rushed through in about two weeks. Testing was done under near-arctic conditions on the ice of Lake Monona.[297] This, the first of the "Detroit" arctic expeditions, ran into a series of mishaps, but it was not entirely a loss. Captain Wilkins and his veteran pilot Lieutenant Karl Ben Eielson covered many miles of hitherto unknown territory, and the Burgess transmitter and receiver, left at Fairbanks, Alaska, were used there with good results for a long time afterwards.

In 1926 radio equipment and batteries were supplied for an expedition into Ethiopia. After reporting on this installation, Hoffman and Schnell added:

> Having had the benefit of experience in cooperating with MacMillan, Wilkins, Byrd and others, the C. F. Burgess Laboratories, Inc. is in a position to meet the severe requirements in

> the construction of this apparatus, which is usually loaned to an expedition in return for the scientific information that accrues from it, especially radio information.

We have mentioned the Burgess batteries used by MacMillan in his North Greenland expedition of 1923-4, and must add that one of the Burgess flashlights then used was afterwards treasured like a family heirloom by Mrs. E-took-a-shoo, wife of a famous Eskimo often featured in the stories of arctic explorers.

Admiral Byrd took Burgess-built equipment with him on his first flight over the North Pole with Floyd Bennett, in May 1926. We have told about the equipment used by him on his first *antarctic* expedition in 1929, and it seems worth while to mention that when he went south again, over four years later, he found that the Burgess products in "Little America" were still in working order. Lieutenant Carl Petersen, his radio operator, in a letter to the Burgess Battery Company, told how after he had dug down through the snow and burrowed into his old quarters, he pressed the telephone buzzer, and "Great was my surprise when Dr. Poulter in the other house answered 'Hello, who is it?' It was rather a funny feeling to talk over a telephone we used four years ago." Dr. Thomas C. Poulter was senior scientist and second in command. This story of the faithful batteries is told also by Admiral Byrd, on page 402 of *The National Geographic Magazine* for October 1935.

This chapter was supposed to be mainly about Burgess Isle. However, we really have not wandered far from our theme; for in its day the island radio station was a not unimportant factor in the development of short-wave communication.

By January 1925 Don Mix had arrived on the island, eager to get the radio station started. We know that he was soon supplied with a desk, for in a letter dated January 22, 1925, Burgess said:

> As I am writing this on Burgess Isle, I am at Mix's desk while he has taken the boat for the mail. Elmer and Bill are remodeling the old mule barn as an office and habitation for myself.

Elmer Alexander was a carpenter, once described by Burgess as the best one in Southern Florida; Bill was William J. Gilchrist, longtime custodian of the island. Burgess joked with them about the incongruity of his "occupying a mule's habitation," and it is not unthinkable that some sly remarks were aimed at his own acknowledged stubbornness.

A humorous diary kept in November 1925 is entitled "A Trip to Florida." On October 23 Burgess had gone to a surgeon "to be fixed up," and then he had been advised to go south for a rest; hence the Florida trip. The diary starts out:

> November 11, 1925. As the outcome of a family council, it was decided that I could be easily spared, and that I could start on a journey to Florida.

The story continues in a facetious vein, and is illustrated with photographs, the first of which shows the front of 416 N. Livingston St., Madi-

son, with Mrs. Burgess and the family dog. Burgess soon meets D. C. Harris and Bill Gilchrist, at Bocagrande, and they set sail for Burgess Isle:

> On rounding Pelican Point, the camp comes to view. . . . (Photograph) The house to the left is the commissary, with an observation platform to detect the approach of rum-runners and to guard against the landing of pirates. Also used as a means of getting away from mosquitos.
>
> The middle house, hidden by the trees, is a workshop, and the one at the right is the radio laboratory, 4DM, which has been in communication with other stations all around the world.
>
> The fleet of boats at the dock consists of two motor boats, one row boat, and a canoe. (More photographs). . . A favorite occupation on Sunday is to stroll along paths cut from the jungle. The feathery masses hanging down from the branches is "Spanish Moss," the material which is gathered by the Burgess Co. of Florida and converted into a commercial product, as a substitute for curled hair. Thus is nature defiled by the commercial instinct.

No mention was made of a house, for the simple reason that no house was yet built. For his temporary residence, Burgess still depended on the famous mule-shed, but when on Useppa Island he lived in the hotel with all the comforts of home. In January 1926 he wrote to Paul Reynolds:

> In the new world in which my family finds itself, the people are the same as in Madison, but with different names. We are enjoying the weather, the food, the people, and therefore have nothing to complain about.

A few days later, in another letter, Burgess again discussed his neighbors:

> Am thrown in with a most interesting class of people down at this hotel. Mostly men of unusual wealth—but most of them with decidedly constricted ideas and abilities.

Mere lack of abilities would not have bothered Burgess very much; but constricted ideas! Men of unusual wealth should have made better use of their quota of mental talents.

Throughout 1926 work on the island continued, especially around the site chosen for a house. There was clearing, grading and planting to be done, and a well to be drilled. D. C. Harris, who was interested in the then promising Spanish moss venture of the Burgess Company of Florida, cooperated by advising about the hiring of help, and in other ways. Burgess was away in Europe for about six weeks, and soon after his return in September he set out for Florida, there to inspect his earthly paradise. A paradise it was indeed, with men and nature working hand in hand. Or so it seemed. But on Saturday, September 18, Mother Nature decided to show her independence, and Florida was visited by a destructive hurricane. Directly in the path of this unwelcome visitor was Burgess Isle.

Damage to trees, buildings and equipment was substantial. The island's boats were destroyed, and Burgess and Bill Gilchrist were marooned. After two days they managed to get to the mainland by paddling a frail canoe.

An important piece of equipment came through the hurricane unscathed, as recounted in an "unsolicited testimonial" received in October by the Fuller & Johnson Corporation, of Madison. This letter, written by W. B. Schulte as Secretary of the C. F. Burgess Laboratories, Inc., refers to a Fuller and Johnson generating plant used for radio transmission and general lighting. It reads in part as follows:

> The roof of the radio building was completely blown off and carried about 500 feet by sheer force of wind.
>
> The engine, generator plant, and storage batteries, weighted down the building so that it was moved less than an inch. During the storm the lighting wires were destroyed and everything was in darkness.
>
> After the storm an examination of the engine and equipment showed that the gasoline feed pipe was flattened. This was opened and we were gratified to find on cranking that the engine started off and ran as if nothing had happened.
>
> Your plant has had a splendid performance record, and we look forward to using it again many seasons. It is a pleasure to take this opportunity of telling you how pleased we are with it.

Burgess liked to have such letters written, and wrote many of them himself. When he was pleased with a certain machine purchased from the DoALL Co., of DesPlaines, Ill., he told them: "Whenever I go by the machine, I feel like shaking hands with it." He believed that good work, no matter by whom done, deserved commendation. This belief dated from his university days, when he was always ready, indeed eager, to spur on his students with praise for tasks well done; and it extended through his industrial years, for whenever an executive mentioned that some employee had done an outstanding job, he would say, "Did you tell him so?" He even wrote letters to utter strangers, commending their praiseworthy achievements; thereby encouraging them to further efforts in the public interest.

Getting back to our island, it should be said that within less than two months the radio laboratory had been rebuilt and other repair work was making good progress; and that Bill Gilchrist had bought a new boat that proved to be better than the old one. Also that preliminary plans were being made for a dwelling, attractive in appearance and sturdy in construction. Houses with roofs that blew off wouldn't do; and something would have to be done about finding an architect.

The architect was C. Sedgwick Moss, of St. Petersburg, Florida, and under his direction much of the work was done in 1928. As might be expected, Burgess had a voice in the specifying of materials. He insulated the house thoroughly with Balsam-Wool at a time when people generally thought that insulation should be applied only to keep out the cold; he knew that in hot climates it is just as essential to insulate against heat.

It is said that he specified also some other improvements in construction based on research carried on at Burgess Laboratories.

By December 1928 "the big house" was considered ready for occupancy, and on the 14th Paul Reynolds received a telegram saying "We just came after good trip. Mrs. B. seems delighted with new home." Mrs. B. *was* delighted. One of the first things she did after getting unpacked was to sit down at what she called her "decrepit but beloved typewriter" and tap out several verses of Christmas greeting, to be signed "Charles and Ida Burgess." Well chosen words they were; a happy blending of related thoughts—the peace of Christmas and the peace of home. And when Ida wrote "From shady porch we look across a sea of turquoise blue," it was like a vision of the tranquil years that were to follow, twelve years of pleasant days for both of them. This was the period when, until checked by World War II, they spent long winters at their island home.

Burgess wrote many letters to Paul Reynolds, describing life on the island. January 4, 1929, he wrote:

> As I am sitting before the grate fire in our living room, I do not have the office facilities for writing, so will merely jot down a few items by pencil. You may not believe it, but I am a busy man these days, with a program something as follows:
>
> After an early breakfast about 8, I take my keen and trusty axe and spend about two hours cutting down mangroves, of which I have about a hundred acres.
>
> Then I go to my office where, in spite of no telephone and few callers, my desk is accumulating the same volume of unfinished business it usually carried in Madison. I have to hurry to get my mail ready for the boat which leaves for Bokeelia shortly after noon.
>
> After an interruption for lunch, I look after farming, planting and building activities, and return to the office where I stay until the supper horn blows.

In January 1929 the first entries appeared in the Burgess guest book. A. M. Hamblet, of Plainfield, N. J., who arrived January 10th and stayed till the 12th, commented "Ideal friends in an ideal setting." Raymond V. Parsons, of New York City, there at the same time, wrote "To be a Crusoe on an isle like this!" Mr. Hamblet was indeed an old friend, but the main object of his visit on this occasion was a business one. As mentioned earlier in our story, he represented the Johns-Manville Corporation, and had come to discuss the licensing arrangement involving Sanacoustic Tile. Mr. Parsons, who accompanied him, was Johns-Manville's consulting engineer. The next signature in the book is that of the architect, C. Sedgwick Moss, and the comment "So delightful to be a guest in this home—the building of it has intrigued me." Abbie Lee Moss followed, with "Thanks to Ida Mae and Charlie for a wonderful week-end." Then on through the years a succession of friendly names and friendly thoughts, in the spirit of an Emerson saying penned at the opening of the book by Burgess himself: "The ornament of a house is the friends who frequent it."

Early among the guests was an old friend from Madison, H. H. Thomas. Mr. Thomas, besides being a successful lawyer, was a sportsman,

and he stayed over a week, having a grand time in his own way. Years later he spoke with appreciation and some amusement of his adventures on Burgess Isle:

> Burgess went fishing with me, on the Gulf. He fished more with me than he did most of the time he was down there.
>
> He said he had guns and ammunition. "That's fine," I said. There were ducks, and so forth, to shoot at. He dragged out his guns and his ammunition—in the original boxes where the Winchester people had packed them, all nicely protected with grease. He had never taken the trouble to take them out of the boxes.
>
> We had plenty of big grape fruit. It was ripe, and it would fall off the trees. We used to put a market basket full in front of the boat; we used them instead of water when we got thirsty. C. F. went fishing with me several times.

Perhaps the most noted name in the guest book is that of Thomas Edison, who with his wife visited the Isle on Sunday March 23, 1930. Burgess and Edison had many interests in common, and shared in one respect a common heritage; both their fathers were natives of Nova Scotia. Now the families were almost neighbors again, for Burgess Isle was only a few miles from Edison's famous winter home at Fort Myers. The great inventor's entry in the book is a triflle shaky, but very legible: "Mr. and Mrs. Thos. A. Edison, Orange, N. Jersey." At 83 he wrote a better hand than most men of half his age; better indeed than most writers of any age. This is not to be wondered at, for the unique handwriting, perfected 65 years earlier, was the product of deliberate research. In his days as a young telegraph operator, Edison had sought, and found, a style of writing that should be at once fast and readable. For his "remarks" in the guest book he wrote "We do not know one millionth % about anything," a saying many times recalled by his host.

Mrs. Edison was mildly disturbed when the motions of her distinguished husband's jaw betrayed the fact that he was chewing tobacco. Mrs. Burgess sympathized; one of the crosses that she had to bear was her husband's addiction to the same habit. Like two incorrigible boys, the two men of science then retired to "another part of the island," and chewed their cuds unchecked by wifely frowns. Burgess confessed to Edison that he was an old offender; as early as 1895, when he was in Cleveland winding armatures for Sidney H. Short, he had got into trouble for spitting a mouthful of tobacco juice through a knothole in the floor, whence it landed on the head of an innocent machinist, whose angry foreman scampered up the stairs to find the blankety-blanked blank who had dared to bespatter one of his men. There was even a rumor that the incident lost Burgess his job; at any rate it did not help him. Edison, who had known Sidney Short, was doubtless amused.

Escorted by Dr. Burgess and by Eric Cotton, then on one of his American visits, Edison trudged around the island on a tour of inspection; and we owe it to his deafness that we still have a partial transcript of his conversation along the way. Burgess communicated with him by penciled words on the pages of a small notebook; he responded orally;

but we still have the notebook half of the conference, and by its aid we can sometimes guess the rest. Here are some typical notations:

"No telephone." This needs no comment; it simply called attention to the fact that the island lacked a phone, and Edison doubtless smiled, for if one had been provided he was too deaf to use it.

"My plan is to keep this a jungle." This explains itself. Luxuriant tropical growth made it easy to keep any part of the island in its jungle state.

"Shell-fish eaters. Burial mounds." These shell-laden mounds, on the higher part of the island, were presumed to have been built by prehistoric races as burial mounds, or possibly as ancient refuse heaps.

"Smart men live long." Quite likely this was a humorous reference to Edison's ripe old age and Burgess's prospects of similar longevity.

"Dinner." "Don't know." "Tired." Three entries suggesting that even smart men are not immune to hunger, ignorance and fatigue.

"Gumbo limbo." This curious tree, with its weird West African name, seems to have fascinated both men. The fine specimen before which they stopped is still pointed out to visitors. As early as 1837 a traveler in Florida had described the gumbo limbo as "a large spreading tree with a smooth brown bark," and had added that "The juice, which is a white milk, is converted into bird-lime by boiling it to the consistency of a soft gum." Such a tree would naturally interest Edison, who for years had been seeking domestic sources of latex, to free the United States from dependence on other countries for its supplies of rubber. He had already found over 1200 rubber-producing plants, and the gumbo limbo was probably an old acquaintance; but it was one of several trees nicked in passing by his trusty pocket-knife, to show the kind of gum it would afford.

"I have made wall board from fibre of Sansiveria." A reference to Sansevieria, the bow-string hemp, a native of the Old World tropics. This item probably led to the next one:

"Have you made any board from fibre of Golden-Rod?" Edison's answer is unknown; but to the next query, *"How many kinds of Golden-Rod?"*, it is known that he reported finding about 120 kinds, most of them in the United States, and that in his search for rubber he had tried them all, with some degree of success. Six months earlier, when Light's Golden Jubilee Committee had asked him to name his favorite flowers, he had voted for heliotropes and dahlias; also "for business reasons," golden-rod. On this visit to Burgess Isle he found a new variety, and gleefully added it to his collection. When Burgess remarked that the cost of the golden-rod process seemed prohibitive, Edison came back with a statement quoted by Burgess as follows:

> That a cost of even a dollar a pound would be no obstacle, if only the rubber were available in quantity, for our country was going to have another war, of greater magnitude than other wars.

Almost eleven years before Pearl Harbor! Perhaps Edison's calm prevision of World War II was based on some first-hand encounters with

the German mind. For twenty-four years he had had a son-in-law who was a German army officer; that relationship had been terminated with the first World War, but not until Edison had caught a glimpse of nationalistic differences which did not augur well for lasting peace. He did not live to see the fulfillment of his prophecy; but Burgess did; and in 1942, when he was sending Mrs. Edison a contribution to the Playground and Recreation Association of America, he recalled her husband's words about the approaching importance of rubber as a war material, adding "What a remarkably clear insight he had into coming events!"

A worth-while postcript to this brief sketch of Edison's visit to Burgess Isle may be quoted from a letter written next day by Eric Cotton:

> Two incidents I shall always remember, and which happened on the way back to the boat, are worthy of mention. One was when he solemnly paused before a bed of flowers and took off his hat to them. The second was when he touched the peculiar fibre-covering of the trunk of a coconut tree and said "The Almighty can also weave."

36.

Burgess Island 1933-1944

A NAME that appears more than once in the guest book of Burgess Isle is that of A. H. Andrews, of Estero, Florida, editor of *The American Eagle*. On one of his visits, March 21, 1933, Mr. Andrews wrote in the book, "An eventful day to be long remembered." He had doubtless had a very good time, traversing the island pathways with his host, and meeting a number of his best friends, the trees. For it should be said that Editor Andrews was a lover of nature, and his newspaper, to which Dr. Burgess sometimes contributed, was in part a horticultural review. Some years earlier, he had introduced Dr. Burgess to several famous botanists, one of whom, Dr. John Clayton Gifford, of Miami, gave valuable advice on the choice of ornamental and useful trees for the island.

It was Mr. Andrews who furnished the first supply of one of the most important of these trees, the cajeput, which he had introduced from Australia in 1912. In the course of time, Dr. Burgess had about six thousand of the trees growing on the island and on his 75-acre farm on nearby Pine Island. The cajeput appealed to him because of its many possible uses. Its bark, which resembles birch bark, could be used for insulating and sound-proofing; its leaves produced an oil employed in medicine and in the preservation of natural-history specimens; and its bloom excelled as a honey-producer. It also promised to be a good source of cellulose. Mr. Andrews received a letter which Dr. Burgess had typewritten, without a ribbon, on a thin slip of cajeput bark. The type impressions were very legible. All in all, the cajeput, with its wide possibilities for research and development, seemed to have been made for Burgess. He sent a considerable quantity of the bark up to Madison, to be studied and processed at the Laboratories. His interest in this tree, and indeed in every kind of plant life, endeared him to the Florida editor, who later said:

> I have observed that people who love horticulture are the highest kind of people intellectually; and Dr. Burgess was one of these.
>
> He was a very wonderful man; one of the best friends I have had.

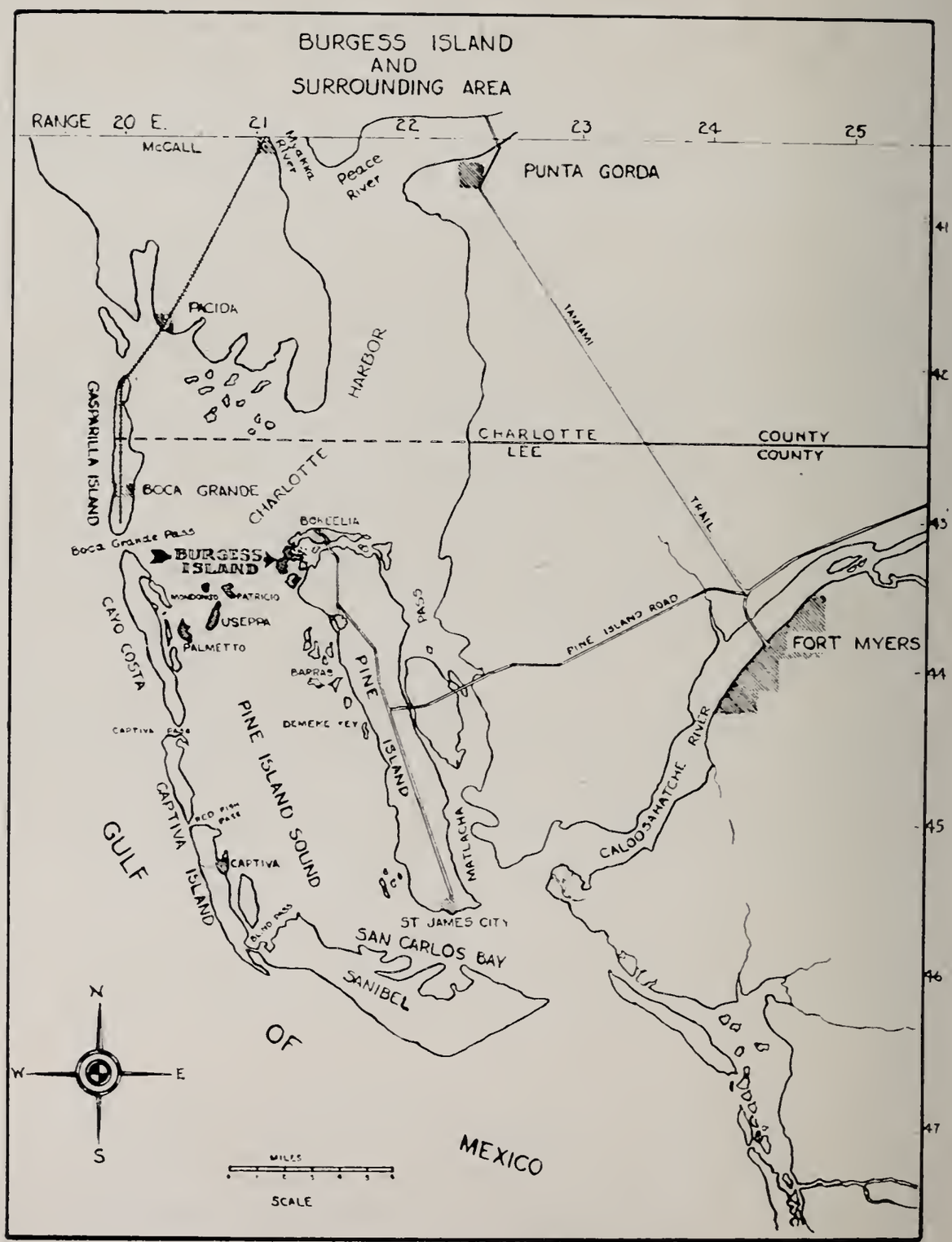
Burgess, always attracted by nonconformists, was interested in Mr. Andrews' acceptance of Koreshanity, a religious belief accompanied by

new concepts of science, especially in the field of cosmology. According to the Koreshan system, "we do not EX-habit the outside of the globe—we are on the *inside* and IN-habit its concave surface." Furthermore, members of the "Koreshan Unity", with headquarters at Estero, had submitted their theory to the test of long and costly research. In this research, conducted along the seacoast of Naples, Florida, they used a unique instrument, the rectilineator, designed to produce a horizontal straight line of indefinite length. Results of their experiments were said to show the surface of the ocean as plainly concave; the dip in the center of the first mile of water was reported as measuring 8 inches, in the second mile 32 inches, in the third mile 6 feet, and in the fourth mile 10 feet 8 inches. Without accepting the implications of this report, Burgess approved the attitude of the men engaged in the experiment; they sought the truth, and hence deserved respect.

A typical guest-book entry is that of January 12, 1933, when W. W. Cargill, of Madison, Wisconsin, who spent several days on Burgess Isle, summed up his impressions with "Rest and interests in abundance." As pointed out in Chapter 26, Mr. Cargill was head of the Ray-o-Vac Company, then as now important manufacturers of batteries and flashlights. The friendly remarks he penned in the guest book convey no hint of serious talks with his host, during one of which, as we have said, he called attention to the fact that Burgess batteries had declined in quality.

Research in the island laboratory was now intensified. Through most of 1933 and into 1934 it was directed almost entirely to the task of restoring lost quality. To Dr. Burgess this situation came as a crisis, not only professional but personal. Not satisfied to regain what had been lost, he exerted every effort to surpass his earlier record. These were days of hard work and interesting experiments, some of them relating to the use of Shawinigan Black. He learned a great deal about the properties of this new product, and was soon able to give valuable information about it to the Shawinigan Company. In the island guest book is an entry dated February 5, 1934, by H. E. Lawson, Jr., one of the battery men from Freeport who was invited down for consultation about batteries. Under "Remarks" Mr. Lawson wrote "That black wax has my sympathy," perhaps a humorous reference to some of the work done on Shawinigan Black.

On April 3, 1934, at a time when Burgess was feeling keenly antagonistic to the business policies of the Roosevelt administration, he was host to one of the most enthusiastic supporters of those policies. This visit is recorded by the signatures of Charles Edison, West Orange, N. J., and his wife, Carolyn H. Edison. The two men shared more than their first names; they had interests in common. Charles Edison was an official of several Edison companies, all engaged in activities of great interest to Charles Burgess. Even in the field of politics they could agree on at least one point—the value of bold research. Burgess had recently declared that "blundering is a necessary adjunct to experiment," and Edison had said that "It takes courage to try new things, and it takes courage to stop them if they are not successful." The spirit of the visit was summed up



Map of Burgess Island and surrounding region

in the guest book when Charles Edison wrote: "Return trip wanted—please," and his wife added "It is hard to leave such a beautiful home and warm hospitality." Mrs. Thomas A. Edison, now widowed, who accompanied them, wrote in reminiscent vein, "Great progress in learning some of the one millionth of 1% of nature since 4 years ago."

Research on the island was carried on in a simple but adequate laboratory, with the aid of several young engineers and chemists. Three or four times a week, Dr. Burgess would get them together and talk to them for about an hour. Describing these sessions, one of them recalls:

> C. F. was interested in us. He was not dogmatic; he used to give us problems.
>
> He tried to give us young fellows a sort of background of the dry battery business, and other things that had branched out of the Burgess industries.
>
> He had a very simple laboratory—a bookcase, a couple of tables, glasses and jars; that was all. He used to say, "All you need for a laboratory is a yard stick and a pint cup. . . . But if you want some equipment, just go ahead and order it."
>
> When he wanted test-tubes, he used to buy glass toothbrush tubes at the dime store; he said: "That way you get a brush too."

Also on the "essential" list were a dry cell and a door bell. Burgess liked to point out that these items, familiar tools to him from early days, had been listed as important by no less an authority than Dr. Charles F. Kettering, of General Motors. Burgess was not stingy. The use of simple makeshift equipment appealed to his sense of the dramatic; some of the world's greatest scientists had been forced to do great things with pitifully poor tools, and Burgess hoped that his young men, subjected to similar limitations, might in like manner be inspired to overcome them. It is to be noted, however, that in the long run he did permit the purchase of modern apparatus.

A fairly frequent island visitor was Jackson Burgess, who often spent a few days in Florida when his family stayed longer. The guest-book entries indicate his frequent changes of residence resulting from the varied needs of business. In 1930, Moline, Illinois. Then New York, and by 1934 it was Freeport. From the latter part of 1937, the address is given as Chicago or Glencoe; and early in 1942 it was Elgin. In his 1938 "Remarks" in the book, Jackson Burgess refers to the fact that a fellow-visitor was "Uncle Charlie"; and sure enough, the next signature is that of Charles Tenney Jackson, Miami Beach, Florida. If Charles Tenney Jackson, Dr. Burgess's brother-in-law, ever takes typewriter in hand and tells the true story of his life, it will be as thrilling as any fiction he ever wrote—and he is the author of many successful novels, some of them first-rate Americana. Student at Wisconsin, army private, Spanish-American war correspondent, staff writer on newspapers, editor, wanderer ("I dislike being fixed to one spot when the land is full of others"), author, realist, idealist—what a life! In the island guest book he seems to be poking fun at someone, with the remark, "Anyhow, I didn't burn up the stock market!"

If all the men, women and children who signed the guest book

View of Burgess home from Burgess Bay

were to meet and exchange memories of their island visits, the blended story would be full of life. Something was always happening; and the things that happened were too many to record under the guest book heading of "Remarks." Take the case of Dr. A. F. Grant Cadenhead, of Shawinigan Falls, Quebec, an island visitor on three occasions. When he signed the book on February 3, 1939, he summed up his impressions with "Burgess Isle: A dream coming true"; but seven years later, after a meeting of The Electrochemical Society, he sat down and recalled some of the wide-awake details of life on the dream island:

> One evening on the beach, Dr. Burgess trotted around in a circle on the sand. In two or three seconds the sand began to swarm with fiddler crabs, all racing away from him till they piled up in the center—a mass of fiddler crabs!

Surrounding crabs with an invisible wall was a favorite stunt; perhaps it served as text for a little sermon on the folly of human beings who flee from imaginary ills only to land in real ones. And if it wasn't crabs, it was ants. Dr. Cadenhead continued:

> He sprinkled acetylene black on some of the island ant hills, because, he said, it was the best ant repellant. The theory was that the black got on to the eyeballs of the ants, and stuck to them! But it didn't work on all kinds of ants. Anyhow, Mrs. Burgess called it off, because *he* got black too.

Which just about cancels out our earlier remark about the owner of an island being monarch of all he surveys. It is true that C. F. was boss; but even the boss has to listen to his wife. Ida often teased Charles about things like the ant-blacking episode. And he liked it. But sometimes when she teased him he protested. One of their bones of contention concerned the climate of their island Eden. When C. F. held forth on the blessings of a winter of tropic warmth, his wife would sometimes say, "One day I found some ice in the bird bath." This would be sure to bring out an emphatic "No—it was never as cold as that." But let us listen again to Dr. Cadenhead:

> Dr. Burgess would observe the way that fishes wiggle their tails, and would say to himself, "Now there's an apparently simple means of locomotion. How can we adapt that to our use?"
>
> He got a man down to the Isle, and put him on the job in his machine-shop to work out the mechanics of that motion, and find out how it could be applied with a minimum of energy absorption to make it useful to the human race.
>
> I actually saw, in a tank, little iron boats propelled by a fin, vertically out behind them, that vibrated. He activated the fin with one of his dry cells.

This line of research was followed for several years, and Burgess often discussed it with his guests. He would say "A tree has no rotary motion; it moves to and fro"; and he believed that the propulsion of automobiles and motorboats could be brought about by vibration in the same way. In 1936, E. L. Chipley, one of the young

Patio of Burgess home on Island

men employed at the island laboratory, spent months catching and pickling fish, so as to be able to experiment with actual fish tails. Some progress was made, but before the project reached the point of commercial efficiency it was shelved. Instead of venturing to class it as a failure, we might call it a suspended success.

More magnificent in scope were Burgess's Florida experiments in trying to harness the radiant energy of the sun. The idea was not a new one; solar cookers and heaters had been used in the Old World at least as early as 1870, and in 1878 a Frenchman named Pifre, during one of the Paris expositions, had issued a daily news-sheet printed on a press run by solar heat. In the Americas, notably after 1900, experiments had been made with motors powered by sun rays reflected from multiple mirrors. A number of installations had been made in California, and some in Arizona. Burgess maintained that Florida's sunshine was second to none, and he spent a great part of one winter studying the problem of solar energy. Then, as stated by one who knew him well:

> Concave mirrors and condensing lenses, both large and small, were erected so as to collect the sun's heat, and various mechanisms were constructed looking toward converting heat into other forms of energy.
>
> Much data and an occasional accident to trousers and other materials inadvertently placed at the focus of the lens resulted in a computation of what might be possible were one acre of the Island to be covered with these lenses and their collected radiant energy converted to other forms.

Suddenly and emphatically the project was dropped. One evening Burgess did some figuring. Keeping in mind his theoretical acre of lenses, he compared the sun-power they offered with the power obtained by devoting the same acre to the raising of quick-growing cellulose crops, harvesting those crops, and generating steam by using them as fuel under a boiler. He discovered that the burning of crops produced by Nature in one year would far exceed in horsepower the man-made energy wrested from the sun using the same acre for the same period. Regardless of its somewhat negative outcome, it had been an interesting experience, and a valuable one.

Seeing Burgess in his glamorous Florida surroundings, doing to a great extent the things he wanted to do, some of his friends thought of him as "living the life of Riley"; and there were times when he himself, momentarily ignoring the cares of business, enjoyed the sensation of full contentment. This was particularly so when he reflected on the sacrifices his parents had made for their children, and when he thought about the hardworking daily routine of his seafaring ancestors. In April 1940, writing from the Isle to his cousin Caroline Church, he said:

> I can recall clearly the heavy boots and slickers, the costume of our immediate predecessors in fighting the battle of life. And as I look out of the "office" window and see my wife wandering

Art Bertrand and C. F. Burgess—experiments with fish-tail propelled boats

> through the flower garden in slacks, the expression "from slickers to slacks" comes to me as a proper characterization of the period through which we have passed.

The picture of Mrs. Burgess "wandering through the flower garden" is a natural one; for she loved flowers, and was glad to be where they grew in abundance. But sometimes she created flowers of thought; and more than one former islander has told of hearing the sound of her typewriter, occasionally well into the night, as she tapped out letters for her friends, or memories of bygone years for her children.

One of the most interesting entries in the guest book was made on the last day of January 1941, with the signatures of "Penny and Jay Darling, Des Moines, Iowa, and Captiva, Fla." Mr. Darling will be recognized as the famous cartoonist, better known as "Ding." He adorned the book with a specimen of art, a sketch of some ducks flying up out of a cat-tail marsh, and the words "Cat tails? Phooey! Them's fur coats and rugs!" Under "Remarks" he added "Better than a day at the Natural History Museum—Ding." The caption to the cartoon is explained in a letter written by Ding, in which he mentions various Burgess experiments:

> For instance, the making of a fine fur coat from the ordinary marsh cat-tail. That was a beautiful piece of work and has commercial possibilities, I think. The rug which he has made of the same material which he kept in front of his fireplace at his home had been walked on and scuffed about for a long time, and showed no wear.

Burgess would try anything. On one occasion he told how he had taken some flounder skins and expected to attach to them some cat-tail fur, "and produce a new kind of product, vegetable fur attached to the hide of a fish." Fantastic! But so was his termite mill; or, with acknowledgments to the *Century Dictionary,* his "termitarium." For a description of this unpredictable device we again quote the friendly testimony of "Ding," who tells how certain boards were attacked by insects, and how Burgess, instead of fighting the critters, joined them:

> He built himself a rack, somewhat similar to an inverted chicken coop, and he stored boards in that rack. Underneath the rack he inserted a long metal pan in which to catch the wood flour produced by the termites.
>
> Each morning he would take the tray from underneath the rack, and there would be a considerable amount of the finest wood flour, which had passed through the digestive system of the termites and fallen down into the tray.
>
> All he had to do was to mix this fine wood flour with a cellulose solvent and he had a perfect plastic wood.
>
> He didn't care anything about more plastic wood, but the quality of this particular product interested him greatly, and the fact that he could make the damnable termites do something worth while was the thing that pleased him most.

The insects used in this whimsical experiment were known locally as termites; no record has been found as to their exact identity.

C. F. Burgess with a gardener and his prize-winning cabbage

In March 1942 came a very special guest, Burgess's friend and mentor of long ago, Dr. Dugald C. Jackson, now of Cambridge, Massachusetts. Accompanied by Mrs. Jackson, "D. C." stayed on the Isle for about a week; and many pleasant hours were spent, recalling happy days at old Wisconsin. During one of their talks, Dr. Jackson said "Don't you get very lonesome here, just cut off from the general population?" Burgess replied, "Oh, no, I have so many things to think about—it's so interesting here." And, remarked Dr. Jackson afterwards, "He *was* very much interested in the things that grew on the island; and he added greatly to the flora there." On this occasion the guests were also good old friends of Mrs. Burgess, and when they left they paid tribute to her in their "Remarks." Mrs. Jackson wrote: "Burgess Isle—a dream of beauty and charm; but the peak of pleasure is the friendship of the patron and patrona." Her husband commented: "A gorgeous place and delightful host and hostess. The lady ought to be a woman's college president." "D. C." knew a good mind when he saw it.

A few days after the Jacksons took their leave, the book was signed by Alvin Meyer, artist and sculptor, then of Pentwater, Michigan, later of Chicago. Mr. Meyer wrote, after a ten-day stay, "Here the process of trial and error gives birth to much that will be of service to mankind." During the balance of his stay in Florida, he took some part in the "trial and error" process; he made various objects to be used in Dr. Burgess's experiments, and some of these were tested in what was known as the sun-box. This glass-topped box, with its inside painted black, was kept outdoors in the blazing sun. An object to be tested would be placed inside, to endure a temperature of about 175 degrees. "If it held out for a day," Mr. Meyer recalls, "that was something; if it held out for a week, that was pretty darn good." In a letter written in the summer of 1942, Dr. Burgess mentions "a little etching done by Alvin Meyer on cajeput bark." It was one of several which depicted scenes on Burgess Isle. These etchings were especially appreciated because they typified the Burgess interest in nature, science, art and handicraft.

At about this time Dr. Burgess took an auto trip through Georgia, and one day he crossed into Alabama and met the noted chemurgist Dr. George Washington Carver. The two men conversed for some time in a field, beyond earshot of anyone else, and no record seems to have been kept of what they said. We can only conjecture that they discussed topics near to both their hearts—the study of all things that grow on earth, the use of all those things to serve mankind. A few months went by, and the venerable southerner took his final leave of the south and of the earth, on January 5, 1943, seventieth birthday of his new friend Charles F. Burgess.

In June 1942 the guest book entries cease, perhaps never to be resumed. The meddling hand of war changed everything. Writing in May 1943, Burgess said, "This is the first time in twenty years that I have not spent several weeks or months in Florida." The call of duty kept him in the north, engaged in work that seemed strangely like that of World War I, except that it was more exacting and more des-

perately needed now than then. But he still maintained his legal residence in Florida, and still made plans for new developments on Burgess Isle and also in the village of Bokeelia. One of his projects involved turning Bokeelia into an industrial village, making handicraft objects of the natural products of the place. One day in 1944 he wrote in his notebook:

> The start that Ed is making points that way. Stuffed products, typha, wood products, gumbo limbo, button wood, cajeput wood, bark, oil, sea beans, sansevieria brushes, ornamental pins, etc.

The reference is to Ed Trenkamp, custodian of Burgess Isle from 1941 to 1947, whose family, "from Grandma to 8-year-old girl," were all skilled handicrafters. One evening Dr. Burgess sat in the Trenkamp's living room and patiently drilled 500 cajeput seeds by hand, for Rosemary Trenkamp to make into a little mat. Two handicrafters working side by side. War interfered with plans to start a little factory at Bokeelia, but the handicraft idea was not allowed to die.

One Sunday night in 1944, Burgess sat in his Chicago apartment at the Lake Shore Club, and made an entry in his diary:

> Sept. 24. Afternoon and evening at our rooms. Am trying to get a system in operation which will make it possible to return to our Florida home. It is over two years, because of war, production and business matters, that we have been boarding, maintaining our island home without having the pleasure of it.

Two nights later, another entry was made, the same in substance, but in tone more urgent:

> Evening at rooms in hotel with Ida. She is getting more and more desirous of breaking loose from this "prison," in which physical disability and war and business conditions keep her—and I sincerely hope we can find means of getting to our Florida home, for the winter months at least.

Then one morning in October came a telegram, with news that must have seemed discouraging:

> Ft. Myers, Fla., 1944 Oct. 20 PM 11:46
> C. F. Burgess
> 180 N. Wabash, Chicago
> We have weathered a very severe hurricane. Damage to buildings on the island light. Lots of trees down. Boat damaged. My family and myself safe and well. Will write just as soon as I get light and plumbing into shape. Haven't checked farm and Bokeelia property as yet.—
>
> Ed. J. Trenkamp

Burgess might have hurried south at once, but he held back for a week or so, remembering that election time was near, and that he would soon have to fly down to vote. When he did go, his faithful notebook went along with him. After he had inspected the hurricane dam-

age, and approved the steps taken to restore things to order, he sat down to write:

> Nov. 5 (Sunday) . . . A beautiful, peaceful day. But a rather forlorn feeling, at that. The Big House is empty without Ida.
>
> Nov. 6 . . . Have become impressed with the vastly different atmosphere (mental) between Chicago and the island. No telephone, no callers, no interruptions.—With a choice collection of books bearing on the past, present and future of science for use of mankind—there is an abundance of inspiration—coupled with a feeling of inferiority and insignificance of my little contributions to the doings of the past fifty years.

Then come memories of his work on batteries, and on what was perhaps his most cherished project, the capillary electrometer.

November 7 was Election Day. Over the water to Bokeelia he went, a duly qualified voter of the State of Florida, County of Lee, to cast his ballot for Thomas E. Dewey. Back to the island he came, to sit in Ed Trenkamp's home and listen to the returns on the radio. The result was not pleasing to him, but it did not surprise him. Nor, indeed, did it unduly discourage him; in a letter written at this time, he said:

> Just now, after devoting all of our efforts to war production, we are beginning to see evidence of a big cutback and an introduction to a new line of troubles. Nevertheless, we can be sure that while there are big changes going on, it means big opportunity.

America was still a land of hope! And whenever the world of politics became too exasperating, a man could always calm himself with science. Or with nature—or with both at once, as suggested in a notebook entry on the island just two days after election:

> Nov. 9 . . . Neil has been telling me of his observations on the shell-borers which attack wood exposed to sea water. Says if you get in a boat on a quite night and calm water, and listen, it will not be long before the teredos begin—sounds "like a woodpecker." He does not know the mechanism by which they gouge out these mathematically exact round holes.

Did he dream of building a perforating machine, with tame teredos boring little holes? It would have made a fine companion piece for the termite mill. "Neil" was Neil Miller, a member of the island staff, as was Mary, his wife. Discussing Dr. Burgess's interest in all things of nature, including even the bothersome mosquito, Neil said recently:

> He never complained about anything—even about bugs. Except once. Then he said, "Bugs are kind of bad this morning, aren't they, Neil?" They had just been eating him up.

No record has been found of plans to train mosquitos in the service of mankind; but Burgess even then was planting trees which

would not reach full growth and use for twenty years; and—again quoting Neil Miller:

> One day someone said to him, "You make your plans a long way ahead. How long do you think you're going to live?" He just laughed.

He did just laugh. But he kept on planning and planting. The day after he wrote about the teredos, he made other notations in his book, in which he discussed a plan for letting some of his Florida land for use in growing papaya trees. These would be used first for their fruit; then, after they had outlived their fruit-growing prime, their trunks were to be made into structural material—presumably some kind of wallboard. When Burgess planned, the central theme was *Use.*

37.

Handicraft Activities 1941-1944

ONE day in the summer of 1941, Burgess turned to his notebook and wrote a few words about the New Deal. Fairly kind words, at that; for in studying what he felt were the troublesome labor policies of the Roosevelt administration, he had come across a by-product which offered some promise of usefulness. So he wrote:

> The day of the home workshop is here—and the number employed in these shops is steadily increasing.
> The Social Security and other New Deal laws are giving to the people more time to spend on "non-labor" pursuits.

To Burgess, "non-labor" pursuits meant handicrafts; and from this time on the name of Burgess was going to be identified very definitely with a movement to encourage people to make things with their hands. Thus far he had been known as student, teacher, inventor, scientist, battery expert, industrialist, and proprietor of a tropical island. Now, in the minds of many new friends, he would be mainly remembered as the man behind the handicraft store. This new kind of renown, at first localized around Chicago and Jacksonville, Florida, later also around Milwaukee and Minneapolis, with much publicity throughout the land, came to Burgess in the closing years of his life; but, he said:

> The conception of the idea or project goes back to the time of my boyhood, when my obsession was to do and to make things —as differentiated from the tasks and routines specified by my parents, school-teachers, and other grown-ups.

The Handicraft Store idea took shape in the early Nineteen-Forties, when Burgess, against the inclination of some of his associates, planned to establish a retail store in downtown Chicago. Although he had made up his mind, he thought it well to spend a little time in research; and to conduct this research, through the last four months of 1940, he engaged George R. Bell, a young man who had had sales and managerial experience with the Nu-Enamel Corporation. One point which Mr. Bell had to consider was the fact that the Battery Company was already involved in a handicraft business which did not measure

The Three Burgess Boys

up to Burgess's requirements. This business had been acquired by accident.

Burgess had wanted to find new uses for the stereotype mat sheet made by the Burgess Cellulose Company. With this end in view, he had sought the aid of a handicrafter and enthusiast named Albert P. Belanger. Belanger went to educational conventions, and showed school teachers how the sheet could be embossed like leather.[284] This product was then sold through craft supply houses, and when one of these houses got into financial trouble, the Battery Company bought it out. Because it was a mail-order business, and the Burgess staff had no experience in handling the countless details of such a business, the enterprise was not altogether satisfactory. It was conducted from a store and warehouse hidden away on the third floor of a building in downtown Chicago, made known to passers-by only by a small display case at street level. Although cash sales reached a respectable figure, the customers were mostly teachers or purchasing agents, whereas Burgess wanted particularly to reach the young people who actually used the material; he wanted them, when they thought of handicrafts, to think of Burgess.

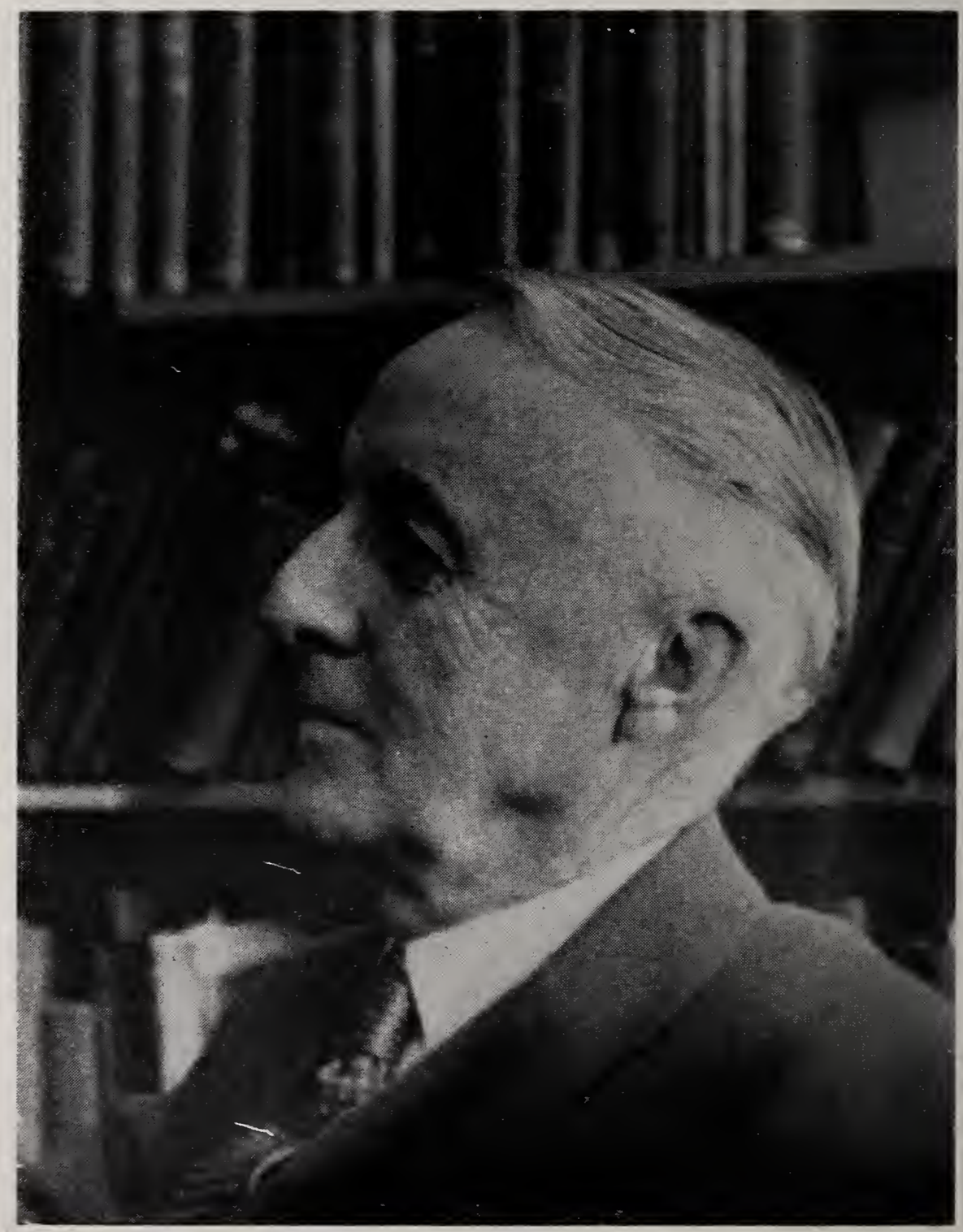
On Saturday May 17, 1941, the new store, 180 North Wabash Avenue, Chicago, was opened for business, and was visited by 375 people, many of whom made purchases. They must have been drawn by the window display, or by the store interior, plainly visible from the sidewalk; there had been no advertising or special publicity. Some of the offerings of the store, as listed in *American Business* for September 1941, were:

> Model airplanes and supplies for making them; hand and power tools; leather work, with supplies and tools; plastics; amateur furniture designing and building; wood burning; metal craft; clay modeling; wood carving; felt craft; block printing; basketry; archery.

In the months and years that followed, other lines were added; and the store, opened without a note of fanfare, received a great deal of favorable publicity, in print and by word of mouth.

After setting up the Chicago store, Mr. Bell, as General Manager, visited Jacksonville, Florida, and developed the handicraft service of a store which had been devoted mainly to the sale of Burgess batteries; this store, at 25 West Duval Street, was the only handicraft store in the South. In due time other Burgess handicraft stores were opened in Milwaukee and in Minneapolis.

It will be noticed that in the list of items for sale no mention is made of Burgess products. Nevertheless, Burgess batteries and flashlights were stocked whenever possible, and the same is true of the embossing sheet, known as Burgess Handi-Sheet. In the summer of 1941 a new item appeared bearing the Burgess name—an item with a romantic past and a promising future. It was the Burgess Vibro-Tool, a versatile electromagnetic hand-tool for engraving, carving, cutting, tooling and embossing; and its romantic past is part of the life story of Miguel de la Torre.



C. F. Burgess—1944

C. F. Burgess in Chicago Handicraft store with group of boys

J. M. Schutte, originator of Handigolf game, sells first set to Dr. C. F. Burgess in Chicago store on August 5, 1944

C. F. Burgess receiving Honorary Doctor of Engineering degree at Illinois Institute of Technology's 50th Anniversary Convocation; being congratulated by Dr. Henry T. Heald, President of Illinois Tech., February 21, 1944

"Mike" de la Torre was born in Mexico, in 1895, and had only a few years' schooling, but he was a born mechanic, and had enterprise enough to register with the International Correspondence Schools, and to take a course in Electrical Engineering. He came to the United States, living first in Georgia and then moving to New Haven, Conn., where he had established a little electrical shop. In 1939 he wrote to the Thordarson Electric Manufacturing Company, then a Burgess affiliate, calling attention to a small electromagnetic hand-tool he had invented, operated by alternating current. He thought that this tool would be useful for engraving, wood carving, marking on glass, metal and plastic surfaces, and possibly for other purposes. No definite action was taken until the correspondence came to the attention of Dr. Burgess, who was at once interested. Electromagnetic vibrating devices had always interested him; forty years earlier he had patented one of them;[111] now here was one with real promise of usefulness. He paid two visits to the New Haven workshop, where De la Torre showed him the new tool which he had tentatively named the "jitter-graver." Then Burgess personally made a deal involving the purchase from Mike of the project with all patent rights,[285] and arranged for Mike to move to Chicago and cooperate with Burgess engineers in further development of the device.

The inventor moved willingly, for he and Burgess got along very well together. But the journey from New Haven to Chicago was not a happy one. Poor De la Torre! He packed his wife and his two children into the family car—and the family car let him down shamefully. From time to time it did not choose to run. From time to time Mike telegraphed Chicago, requesting funds to help him with the car. When, at long last, he arrived, he went to work as arranged.

By the spring of 1941, after certain improvements had been made under Burgess's direct supervision, the project was taken over by the Handicraft Division of the Battery Company, and the tool, re-named the Burgess Vibro-Tool, was considered ready for trial sale to the public. This was good news for the handicraft stores, where, on June 26, 1941, the first Vibro-Tool sale was made to Jackson Burgess. On several Saturdays during the summer, Miguel de la Torre, who was superintending the manufacture of the tools, conducted Vibro-Tool demonstrations in the store. In September a regular demonstrator was engaged, and he gave daily demonstrations in the front window of the store for the balance of 1941, and Saturday demonstrations during January and February 1942. In March this program had to be discontinued, when the supply of Vibro-Tools for the general public was limited by war priorities. These priorities did not hinder the manufacture of the Vibro-Tool for defense purposes; during the war it was rated as an important and useful marking device in most of the war plants, and large quantities were made, using materials allocated by the government.

At about this time, Burgess wrote in his notebook that Miguel de la Torre, a man of limited educational advantages, was one of several men "who have given me the greatest assistance during the past two years." De la Torre died in 1946, at the age of 51. His story has been briefly sketched here because his jitter-graver, developed into the Burgess Vibro-

Tool, was an important addition to the merchandise sold, and to the interest aroused, in the handicraft stores.

Very different from the Vibro-Tool was another product featured by the stores for some time—the fluff of our old friend the cattail, promoted under its botanical name of Typha. Retail customers used the material in many ways, largely for stuffing pillows and toys. Makers of military supplies, learning of its buoyancy value, adapted it to wartime uses, and this brought it to the attention of government agencies, hitherto unwilling to consider it in place of non-obtainable kapok. Typha, harvested on a large scale and eventually marketed by the Burgess-Manning Company, achieved national recognition;[254] this recognition was in part due to the activities of the handicraft store in Chicago.

Members of The Electrochemical Society, meeting in October 1942 at Detroit, heard about the handicraft stores. In a speech preceding the conferring of the Edward Goodrich Acheson Medal on Dr. Burgess, Mr. George W. Heise[238] said:

> Burgess strongly believes that the future industrial development on which our economic welfare is dependent may well come from the seeds planted today in home gardens, home workshops and small laboratories. An offshoot of this idea has been the recent establishment of two "Handicraft Service" shops to make more and better materials available to the home worker, and to stimulate the public to learn of and practice some of the ideas which may be derived from our scientific and technical laboratories.

The Acheson Medal, awarded to Burgess for his achievements in electrochemistry, and notably for his work in developing and improving the dry battery, carried with it a prize of $1,000. Burgess accepted the medal[86] with pride and pleasure, but asked that the money prize be "retained as a re-enforcement of the Edward Goodrich Acheson Medal Fund of which The Electrochemical Society is custodian."

As to the handicraft stores, Burgess realized that they had come into existence largely by accident, and he filled the pages of his diary with lists of reasons for their existence, and of ends which they might be made to serve. As it turned out, they earned a great deal of favorable publicity, and proved to be an excellent means of establishing new contacts. They enabled Burgess to learn more about people, people to learn more about Burgess.

Singly and in groups they came, handicrafters, inventors, boys—and girls—interested in building model airplanes; fathers and mothers, teachers, manual training experts, hobbyists of all kinds. Many of them came repeatedly, and at frequent intervals. Sometimes General Manager Bell would steer a customer upstairs to the office of the Battery Company for a talk with Dr. Burgess. "C. F." liked to talk to these visitors, even when, as sometimes happened, the results were not exactly enlightening. He insisted that he learned something, even from the least promising interview. One day he sat and talked to a Mr. X, introduced by Bell. The man was an inventor, and therefore worthy of a respectful hearing. In the notebook we read:

> He is an inventor. He claims to have no business knowledge or sense. Evidently true. Another example of what our store invites.

Perhaps it wasn't an ideal interview. But Mr. X and Dr. B. both got something out of it. Another note is very different; it concerns Mr. R. V. Foster, of Rochester:

> Former trapeze artist who has made a hobby of collecting miniature articles of a novelty appeal. . . . He has marvelous specimens—an ivory camel just barely perceptible to the naked eye—a complete desk with accurately fitting drawers, 1-inch dimension. Miniature books, framed pictures, etc. This could be developed into a real new handicraft.

One never knew what sort of individual would come next. One summer day in 1943, the notebook states:

> Bell brought Mr. McQueen into my office, where we had an hour's discussion. McQ. is a radio commentator, "Nothing but the Truth." He is a publicist—a translator of new, interesting ideas to the public. I can see how such a man could be made an important adjunct to our handicraft division. . . . Wish to discuss things with McQ.

This man did not come back until it was too late to talk things over with Dr. Burgess. But in a small and unexpected way he was destined to serve the handicraft division, and to be at least temporarily allied with the House of Burgess; perhaps it was a sort of posthumous concession to the founder's impulse to employ virtually everyone in sight. Following this impulse, Dr. Burgess had been inclined to *attach* to his organization a succession of chemists, inventors, engineers and miscellaneous workers, some of them admittedly a bit eccentric. He admired eccentric people, if only for their daring to be different.

As a man of science, Dr. Burgess knew that he could never be sure of the value of these people to his organization; but he knew that progress in science had often been aided by a bold guess, and he was willing to hazard an occasional guess on the value of a chemist or engineer. He often spoke of guessing; for example, in June 1943 he wrote in his notebook:

> It is my guess that the retail store project will assume greater importance as a pilot plant for sales development of new products.

This guess turned out to be a good one. The Chicago store provided a quick testing ground for public reaction to the Vibro-Tool and other items. It also gave Burgess himself some personal experiences which he much enjoyed. One of these is recorded in his notes for January 29, 1944:

> Had a curious demonstration today. Spent about half an hour in store, being bareheaded. This gave impression that I was a clerk, and numerous customers appealed to me for information. Had a good time talking to boys about airplanes.

> I know I would enjoy this kind of job. But the idea I get is that old men might make mighty effective clerks, especially if they like boys. Will make further observations.

A few days later, in February, he wrote of the handicraft stores as "a good medium for association with the teen-age generation." Then he went on:

> I have been reading lately of surveys being made by various business houses in preparation for post-war activity; these being in the nature of interviews with men and women to find out what they intend to buy when free to do so.
>
> This seems to be futile compared with a study of what the young boys and girls are now interested in. That is going to be the interest which will continue for years to come.
>
> Now the young people are interested above all else in aerial matters—airplanes, wings, motors, kites. Next in interest is boats. Then land locomotion.

Then he turned to a subject often referred to in his notes, the fact that a machinist or even a boiler-maker need not necessarily be of the sterner sex:

> The great influx of women into factories is giving to the young girls a confidence in their ability to do shop work, handle tools, make things—handicrafts other than knitting and sewing. They will carry this interest into peace time. Soldering and welding will be in their line. Tools adapted to women's hands will be in natural demand. Metals, plastics, adhesives, will be as interesting to them as to boys.

But regardless of what might happen to the girls and women, there was no doubt as to the part to be played in a busy post-war world by the boys:

> At the end of the last war the boys were absorbed in radio. They became an active class of radio amateurs—"hams" who played a grand part in developing what is now known as the electronics industries. Those hams are now largely employed as managers of this industry.
>
> Burgess Battery Co. and Laboratories became closely associated with these "hams" and with all of the pioneer adventures in which radio played a part. This association became of great value in the 20's when radio made its phenomenal growth.
>
> Many call it "luck" that our company was connected with this new activity. As a matter of fact it was the result of our direct interest in amateurs. The opportunity of having this same luck during the coming decade is just as good as it was then, if we will play along with our young people.

On June 7, 1944, the notebook carries a few words to be used in a talk to the staff of the Chicago handicraft store:

> You have probably seen me while asking boys whether they carry knives in their pockets. Why—I can learn more from boys than from any others.

> I like to see what they have in their pockets, as it shows what interests them. It is a habit of carrying things in my pocket which I have never gotten over.

One of the habits Burgess had admired in Thomas A. Edison was the habit of carrying a sturdy pocket-knife ready for any task of cutting, marking or whittling.

Another notation in June 1944 refers to an order for 100 "Natur Brushes." The Natur Brush was a Florida product, from the stalk of the Sansevieria plant. The order for 100 came from a Chicago weaver of drapery trim; and it was the result of a display of the brushes, along with other Florida handicraft products, in the Chicago store. Burgess was delighted; he visited the concern "to learn about requirements," and, he reports:

> I found there just what I have been looking for for several years—a good practical use for brushes 1″ over-all length, one that conserves the sansevieria stalk.
>
> It is used as a needle brush to keep needle free from lint and to close the finger at end of needle which operates back and forth through the brush at a high speed. . . . I saw some of the brushes in the loom.

In going back to nature for this brush, Dr. Burgess was doing what other men had done in ancient India; for in the Sanskrit *Dictionary* of Monier-Williams we find the word *tuli* defined as a "fibrous stick or brush used by weavers for cleaning the threads of the woof," and we learn that this brush came virtually ready-made from a certain tree.

The making of Natur-Brushes, a relatively simple process, was a good example of handicraft; and "handicraft" suggested busy hands. On June 7, 1944, when Dr. Burgess was making notes for a talk, he wrote:

> The most remarkable mechanism ever created is the human hand. . . . It gives rise to the term "Handicraft."

The word "hobby" was not so desirable. Some hobbies were not manual; some, such as reading, involved very little physical exertion. In adopting the word "handicraft," Dr. Burgess was faced with the fact that he would have to give it a meaning not clearly recognized in the dictionaries; they paid little attention to its amateur aspect, and that is the aspect he wanted to stress. Seeking a new definition, he interviewed people around the store and offices, asking them what "handicraft" meant to them. He then offered a small prize, and awarded it for the definition which was considered best:

> Handicraft is a pleasurable non-commercial occupation wherein the head guides the hand in fashioning materials into desired products.

Not the easiest thing in the world to remember; but Dr. Burgess expected people to memorize it, and often asked his employees to recite it to him. At any rate, it introduced the expression "non-commercial," an

expression which does not necessarily mean useless. Perhaps the most gracious thing about the handicraft movement is that it provides pleasant, useful activities in an atmosphere free from burdensome thoughts of dollars and cents. In such an atmosphere production thrives. This was the atmosphere shared by Burgess with his family, including, as he often liked to record, his womenfolk. One day in July he was delighted to get a suggestion along handicraft lines from his wife. It concerned a new use for the cattail:

> (July 22) Ida has given excellent suggestion of making blackboard erasers. Question: Can the eraser be cleaned? So washed with soap and water, which cleaned it (Typha).
>
> (July 23) Tried out the cattail brush as blackboard cleaner. It works fully as well—perhaps better than—the usual felt strip type.

This recalls an earlier entry in which he quotes with pride a letter from his daughter Betty in England. After stating that a powder-puff she had fashioned from cattail had been in use for six years she added, "I can see that if all else fails I can support the family by supplying the world with the Perfecto Powder Puff."

This starts her father off with:

> While this may have been written in semi-humorous vein, it means much to me as an index to Betty's interest in kind of occupation that appeals to me. If the Typha becomes an important industry as now appears likely, Betty probably wins the distinction of being the pioneer who has a record of longest continuous practical use of typha.
>
> It is a sample of how a handicrafter starts something which when widely spread becomes an industry. Good for Betty!

On December 22, 1944, the people at the Chicago store had a Christmas party. In his notebook Burgess wrote:

> Attended annual meeting of the Handicraft Division. Kissed all the girls—25 of them.

From which we might gather that the handicraft situation was well in hand. As a matter of fact, it was. Within less than four years of the opening of the store, it was beginning to become a landmark, at least to the amateur workers for whom it was established. Although not in the most ideal location, it had been discovered by thousands of handicrafters of both sexes and all ages, from widely separated sections of one of the greatest cities in the world. "My young son goes there every Saturday," said a Chicago mother. "I can't keep him away from the place." She didn't want to keep him away. She had come to realize that what he saw and learned there was all to the good. Twenty years earlier his father had built radios; now the boy was building model airplanes; the same old joy of doing, but something new to do.

One day when Dr. Burgess was riding on the train from Madison with George R. Bell, general manager of the stores, they walked into the

diner and sat at a table where two other men were already being served. The four were soon engaged in conversation along business lines; then came introductions. As soon as the strangers heard the name Burgess, one of them said, "Oh, of course—you are the Mr. Burgess who runs the Handicraft Store in Chicago. I have been there many times." C. F. Burgess nodded and smiled. He had been proud when men had recognized his achievements in the fields of education, science and industry; now he was proud in a new and unexpected way when they hailed him as the power behind a new and unexpected store.

38.

1943-1944

"YOU have all your life ahead of you; I have only a few years." The speaker was Charles F. Burgess; the time, 1943. The young man to whom the words were spoken had been entrusted with a research project, probably one concerning Illium; Burgess, eager to see results, had suggested that it would be well to hurry. Then came his reference to the flight of time.

Burgess was seventy. Judged by his father's age, he still had thirteen years to go. Little enough, considering all his plans. What with Illium, vibratory propulsion of boats, cajeput timber and by-products, half a dozen other ventures in chemurgy, and re-dedication to the study of old projects, including the coy but ever-promising capillary electrometer—thirteen years would be nothing; the cajeput scheme alone might take eighteen. So let others look after unfinished business; he would pitch in and take care of unfinished research. Not to be forgotten were his studies in the field of electrolytic iron and iron alloys; possibly he could persuade his old colleague James Aston to join him in further experimenting in this field. A most alluring enterprise; and it was but one of many. The entries in his notebook are an index to his thoughts; and in 1943 his thoughts were definitely slanted toward withdrawal from contact with the details of business. Let us see what he wrote about his activities of Tuesday, January 19:

> Meeting of Board of Burgess Battery Company. Asked Hirtle to preside. He did excellent job, and I tried to keep my mouth shut—with only moderate success.

Even moderate success was something. The art, or science, of keeping quiet is not an easy one. One Sunday in February he returns to the problem uppermost in his mind:

> I am in the anomalous position of Chairman, where many matters of a business and administrative nature require most of my time—while for greatest pleasure and probably usefulness I have longed to get seriously into experimental work.

Meanwhile things happened every day to make life interesting, and to suggest problems which might sooner or later be solved by the use of

Burgess products. On another February day he notes:

> Had talk with building manager, about polishing the brass handles and doors at entrance of building. It takes 4 man-hours of work per day to polish the brass fixtures and handles of 8 swinging doors; @ 50c per hour equals $2. per day, or $600 per year. This could be saved were illium trim employed.

Some notes in the early months of 1943 were very full; the record of a single day's events often filled several pages. Perhaps the diary was becoming a burden. On March 7 Burgess wrote:

> I have been finding it impossible to keep up the system of notes such as practiced during the past few weeks. It has taken about two hours, sometimes longer, from 10 P. M. on—and I find that I am not getting enough sleep.

The note-keeping habit—a habit by no means limited to "the past few weeks"—was not easily abandoned or modified. Not much change is noticeable in the length or frequency of notebook entries; and they continue to reflect the thoughts of the writer, both serious and light. Sometimes we feel a touch of quiet humor. At a meeting on March 22, Burgess had listened with interest as Mr. Thomas N. Burke told his fellow directors of the Burgess Battery Company about a new type of confessional booth manufactured by their Acoustic Division. This booth, akin to one of their other devices, a relatively soundproof telephone booth with an open doorway,[288] had aroused immediate interest in church circles. Burgess, always delighted to hear of the success of new developments, recorded this incident with satisfaction; then quaintly blending commercial and spiritual comment, he added: "A good prospect for the hereafter."

Like many other fathers, from Adam's time till now, Burgess often found it hard to get close to his son. In one way they were very much alike—they were both independent. But the independence that made them alike in spirit, sometimes made them different in their viewpoints. Naturally, this had not always been the case; for a number of years, say up to the middle 1930's, the younger man's cooperation had been almost taken for granted. Then, as he began to form his own opinions, they did not always follow the expected line. This state of affairs is reflected in many of the notebook entries made by C. F. Burgess; some of them say, in effect, "Why on earth can't my son see things as I do?", while others seem to say, "I'm glad he has the grit to think for himself." In the notebook, Jackson Burgess is "J. B."; as on August 3, 1943:

> J. B. called at office early this morning, on way home from Wisconsin Camp. Spent a couple of hours, and seemed more willing to talk about affairs than for a long time.
>
> I succeeded fairly well in refraining from dishing out advice and opinions; hard to break old habits and inclinations.

Simple words, but full of meaning. Two men who had never really been far apart, were forging new bonds of affection and respect. One was

"more willing to talk about affairs"; the other was being true to his oft-repeated rule that each generation must be free to make its own decisions. And as Burgess looked at the world beset with every kind of trouble, his faith in the new generation was expressed in terms of hope; for on August 6 he wrote:

> What will happen here when peace comes? I am inclined to believe that the spirit of enterprise will continue to live.

And he expressed his own spirit of enterprise in a memorandum which to a mind less daring might have seemed fantastic:

> Can we get Barney Baruch to work for us?

He was always making fanciful plans to put people to work at "something else" in which their talents might be employed differently. On August 6, when he attended the launching of two ships, at Sturgeon Bay, Wisconsin, he made this notation:

> Lt. Commander Andrews seems to be the head guy, planted there by Navy and doing a good job. He will be a good industrial executive when war is over.

One of the ships on this occasion was launched by Joan Burgess, a daughter of his youngest brother Kenneth.

Publicity of an unexpected kind came to Burgess when the *Saturday Evening Post,* in its issue of August 14, 1943 printed an article about him. He felt highly complimented. The article, written by Robert M. Yoder, was entitled "Pipe Line to Inventiveness,"[251] and caused Burgess to receive hundreds of letters from handicrafters, inventors, and others. On August 26, he commented:

> Have been getting numerous letters stimulated by the *Saturday Evening Post* publicity. A new kind of experience. Have been answering most of them. In doing so will probably stimulate a lot more troubles; but this is part of the game.

On Wednesday September 22, 1943, after several days of Burgess Company meetings, he returned to an old theme. Mentioning that disturbed business conditions had prevented his retiring from active management as he had desired ten years earlier, he wrote:

> These few days have been momentous from my point of view. I have purposely sat on side lines, watching Hirtle engineer the proceedings for Burgess Battery Co., and J. B. for Burgess Laboratories. They did excellently.

This time he says nothing about trouble in keeping his mouth shut; but he adds:

> I have for a long time wondered how it would be to relinquish all control, and then watch how affairs would be handled by the group I have helped create; to see whether the policies built up on many years experience would continue to prevail.

> I did realize that I would witness departures—that I would have disappointments; that I would be tempted to get back and exercise authority. All these have come to pass. And I now realize the impossibility of relinquishing authority while continuing in existence.

The last remark grew out of something which had happened at lunch time. One of his younger executives—perhaps the youngest—had definitely disagreed with him on certain matters of policy, and this, Burgess said, had been a "serious disappointment":

> His stock went up in my estimation, however, when he was frank enough to express as his belief that until I pass out of the picture completely, no executive talent can be developed in others.

The young man felt some misgivings about his own frankness; in being unafraid had he also been unkind? Perhaps not as unkind as he imagined. After all, he was dealing with a philosopher; and the very next words in the philosopher's notebook are penned without a trace of bitterness:

> This is another way of saying that the lessons of experience gained through many years of work cannot be passed on to the younger generations. Each generation wishes to make its own mistakes and create its own policies. This is perhaps a necessary law of nature, with which I do not care to take issue.

Law of nature or not, Burgess would still like to have his own way in some things:

> I do however have certain pet projects which it would please me greatly to see materialize. For this I need enthusiastic support. Am looking for it, but it seems to be a scarce commodity.

Soon the deck would be cleared, when, as explained later, he would be in a position to devote time to the pet projects, and to enlist the type of aid he felt he needed. Meanwhile the passing days were full of interest, and some days brought events of inspiration.

One inspiring event was a dinner in honor of one of Burgess's electrochemical friends, Dr. Wallace P. Cohoe, of New York. This dinner, given on October 22nd, 1943, at the Waldorf-Astoria Hotel, was in recognition of the fact that Canadian-born Dr. Cohoe had been elected International President of the Society of Chemical Industry. The event, regarded as a British meeting, "under the patronage of His Majesty the King," was attended by representatives of the U. S. State Department, and of many foreign governments. The dinner was actually given by the American Section of the Society, and Dr. Burgess, listed in the elaborate program as a guest of honor, was one of the affair's patrons. He contributed liberally to the American Section's fund for the financing of the affair. Chairman S. D. Kirkpatrick of the American Section wrote asking whether the contribution was personal or from the Burgess Battery Company. Burgess replied:

> While I had intended to send my check as a personal contribution, it is entirely proper to make the Burgess Battery Company the patron, and if this seems more fitting from your point of view, I will leave it entirely to your good judgment.

When he looked through the program, he was gratified to see Burgess Battery Company listed as a patron, together with a long list of the outstanding chemical companies of America.

Early in January 1944 he ran up to Madison, and during his short stay there he found time to visit his good friend Albert G. Schmedeman, former Governor of Wisconsin, who was confined to his home by sickness. A few days later George Boissard wrote to Burgess that he too had been to see "old Al Schmedeman":

> Found him brighter than he's been for two or three months, and almost the first thing he said was: "How fine Charley Burgess is looking!"
>
> Then he went on to tell me you'd called on some of your old students—or tried to—who had been on the University faculty, and found they had been retired on account of age. "They'll never retire Burgess," said Al.
>
> Kate (Mrs. S.) told me, as she let me out below, that she didn't know of anything that had happened since their son was home in September that did Al so much good as your visit.
>
> You've finished up your Boy Scout work for the year!

Burgess was not literally a Boy Scout, but he had always been in full accord with Scout principles. He constantly reminded himself that the nation's future depends on the nation's boys. He liked to help boys, mainly by showing them how to do things for themselves, and he knew from experience that boys do not forget. This oft-recurring thought appears in a notebook entry dated January 15, 1944:

> With our cattail development we are getting in touch with the younger generation—many of whom are earning money by collecting it. The memory that Burgess Co. is interested in turning weeds to use will remain.

The harvesting of cattail was indeed profitable to young and old, as mentioned in a note on February 8:

> Manning returned from Minnesota, where he found plenty of excitement—almost as much as in a mining camp—all over the fact that unexpected money was rolling this way—$100,000 poured into this district in a short time means a lot. One of our agents has made over $4000 in two months—another probably more.

In the next day's notes a question was asked, as to whether the typha might not be used to lessen the danger from oil burning on the surface of water, especially in warfare. The idea was that the typha, because of its affinity for oil, could be used to gather up the oil and thereby keep the flames from spreading. Burgess often discussed the cattail's thirst for oil. A few days later he wrote:

> I have often been served hot soup with more grease floating on the surface than wanted. A piece of typha fur would be means of removal.

He sometimes carried "A piece of typha fur" in his pocket, to show to his friends or to anyone else who would pay attention, but it is not known that he ever caused excitement in a restaurant by sweeping the surface of his soup with a Burgess Patent De-Greaser.

On January 26 a letter came from Los Angeles announcing the death, on January 4, of a cherished friend and Beta brother, George Edwin O'Neil, the "Pat" O'Neil who has appeared and reappeared throughout our story. To Burgess this news came as a severe shock, for he did not know that his old room-mate had been seriously ill. Another lifelong friend had crossed the bar.

On February 5 he wrote in his notebook, with mild annoyance, "Wish that X could have better sense of proportion between important and unimportant matters." Presumably X was not noted for exercising good judgment. But was it always easy to be sure that a thing was unimportant? On a point like this, even learned men could disagree.

On February 9 Burgess noted that he had been to a meeting of The Electrochemical Society, and there had a chat with its president, Dr. H. J. Creighton. Dr. Creighton, Professor of Chemistry at Swarthmore, was a native of Nova Scotia, birthplace of Burgess's parents. They got to talking about Dr. Felix Ehrenhaft, a well-known physicist, credited with notable work in the field of magnetism. This work interested Burgess because it supplemented knowledge he had gained years earlier while investigating the magnetic properties of iron alloys for the Carnegie Institution. Dr. Ehrenhaft, in his work on magnetism, had boldly rejected many of the older concepts, and in some scientific circles the very sound of his name brought shudders. Burgess seems to have felt that shuddering was better than inertia. He once wrote to Dr. Ehrenhaft:

> I have seen numerous references in the papers concerning your work, some of them being corroborative and others adversely critical. Out of it all I gather justification for offering my sincere congratulations, for you have certainly succeeded in "stirring up the animals" and getting them to pay attention to your experiments and deductions.

Early in 1944 Burgess began to read a book which had been lying around for some time; and as he read it must have been reminded again of the unconventional Dr. Ehrenhaft. The book, by the Canadian-born Professor S. I. Hayakawa, seemed to be about words, but it was really about thoughts; it was in large part a plea for independent thinking; it condemned "unfounded complacency" and the habit of depending upon "false knowledge, that robs us of whatever good sense we were born with." Here is Burgess's note, dated February 14:

> Evening spent on *Language in Action* by Hayakawa, of Ill. Inst. of Technology. It should be read by all who write and read

> reports. Recommended in the O'Brien column—to which I have become something of an addict since he has devoted it to discussing words and their meaning.

It must have pleased Burgess to learn that the groundwork for *Language in Action* had been laid when its author was teaching English at the University of Wisconsin. Again his Alma Mater had shown that the Wisconsin Idea was more than a notion—that it was a striving to transform knowledge into wisdom, and thus relate scholarship to life. The columnist referred to was Howard Vincent O'Brien, of the *Chicago Daily News,* whose paragraphs on everyday speech were very popular. Burgess's interest in the effective use of words was shared by his wife. Years before, in a letter to the young son of one of his friends, he had written:

> I gave my wife a dictionary for Christmas, and she said it was the best present she had. You know that words are mighty interesting and important things, and the ability to put the right words together in the right way has given many men the reputation of being great men.

His own reputation, built on deeds as well as words, was well established. But further recognition was to come. On February 17 he learned that Harvard, through its Research Department, had decided that typha was superior to kapok in buoyancy, and had asked permission to name Burgess as originator of the material. No longer humble, the cattail could speak with a Harvard accent. This triumph, a minor one, was gratifying. But on February 21 Burgess received a definitely scholastic honor, when, at the 50th anniversary convocation of the Illinois Institute of Technology, he was awarded the honorary degree of Doctor of Engineering, given to him, according to the citation:

> For his inventive genius recognized by awards from engineering and scientific societies, and evidenced by his many patents; in particular, as inventor of the process for electrolytic purifications of iron and other electrochemical processes; and as an administrator whose tireless efforts have contributed to the industrial development of this country.

The pleasure of the occasion was intensified by the fact that Mrs. Burgess was well enough to be in the audience, when, in the language of George Boissard, "they pinned the latest medal on your chest." The citation's reference to "tireless efforts" was in line with some remarks made by Burgess two days earlier in a letter to T. E. Johnson, of the Burgess-Parr Company:

> It happens that I am interested in about a dozen different lines of business, but I have yet been unable to find one which is free from difficulties and handicaps. In fact, this seems to be what business is—the meeting of difficulties and finding ways to get around them.

If someone else overcame a difficulty, Burgess was ready with a word of praise. He was immensely pleased when Al Belanger, already

mentioned in connection with handicrafts, devised a new, economical method of protecting the lugs on bombs from damage during shipment,[290] for which he had received a distinguished service citation from the Ordnance Department. On Leap Year Day 1944, a notebook entry reads:

> Exhibit, Belanger's Bomb Bands. These are bomb rings made of paper—standard method of protecting bombs for transportation. Millions of pounds of critical steel have been saved by this invention, made by a former member of this Handicraft Division.

At about this point in the notebook, two loose scraps of papers were found. They were plainly not entries, but nevertheless they had a tale to tell. One of them was a penciled list, in Burgess's handwriting, of cash assets. The total was important, and therefore interesting. But it should be considered in relation to the other scrap of paper, which happened to be a blank book-call slip of the John Crerar Library, Chicago. The two pieces of paper were symbolic; the library slip stood for research, the cash assets stood for the *results* of research.

39.

Re-establishing Activities of Burgess Laboratories 1944

"WHILE shaving this morning—."As every man knows, all sorts of things and thoughts occur while shaving; but the four words which introduce this chapter had a special meaning when C. F. Burgess wrote them in his notebook on March 6, 1944, for it seems that during his morning shave he figured out an important improvement in the construction of dry batteries. Details of the discovery were doubtless recorded elsewhere; but the notes continued with a handy definition:

> Invention consists in combining two or more known facts, or ideas, into a new combination to produce useful results.

Burgess looked forward to a day when all young people would be potential inventors; and he wanted to help them acquire the two or more facts without which they could not hope to start. The best beginning he could think of was through handicrafts, and he was glad to have his views endorsed by one of his friends, Dr. John J. Grebe, of the Dow Chemical Company, who wrote:

> There would be nothing better than a more general appreciation and use of simple tools, especially in the early years of our children's lives. By the time youngsters are fourteen, they should know how to build a shack; shape, fire and glaze pottery; and take care of domestic animals; as well as to hunt, trap, and fish. Their lives would be so much richer, and their understanding of nature so much better!

A few weeks later, Dr. Grebe took a trip to Chicago, and here is a notebook entry dated April 1, 1944:

> Had a visit from Dr. Grebe of Dow Chemical. A most enjoyable experience, for we have many points of common interest.
>
> He is an enthusiast on "vibration," the basic phenomenon of nature and life. His interest is philosophical and scientific—mine amateur and handicraft. He is greatly interested in our Handicraft store; spent some time in the store.
>
> Grebe told me that my diversified interests and methods of attack reminded him of H. H. Dow, whose protege he was. This I received and accepted as an exaggerated compliment.

It was probably more than a mere compliment. Other friends of Dow and Burgess have been known to make the same comparison. Another reference to Dow appears in the notebook on June 1:

> Have been reading a pamphlet issued by Dow Chemical Company, giving a history of the company especially as it related to magnesium. Am reminded of my early contacts with H. H. Dow, and his visits with me at Madison. We had many interests in common, and were both impressed with possibilities of magnesium as a battery anode.
>
> Am complimented in this pamphlet by a reference to the incident where I had been considered as a suitable referee to go to Germany and examine into the German methods of making magnesium, an assignment which I was not in a position to accept.

On the night of June 5, before Burgess retired, he made some notes which he felt were of unusual importance:

> This has been a notable day--for A. R. Welton appeared, and took hold, as President of Burgess Laboratories. It gave me renewed hope that through him I may be able to devote at least a fair part of my time to the kind of effort which gives me greatest pleasure—research and development.
>
> Item No. 2 is finding that Jack is apparently handling the task he has undertaken at Thordarson E. M. Co. with a strong heart and decided enthusiasm.
>
> Item No. 3—I went to Bussey's Lab., where he demonstrated that the dream which I had over forty-five years ago has become a reality. It is possible to use a capillary electrometer as a microphone.

Then came a brief notation, evidently made after the dawn of D-Day, June 6, 1944:

> The great invasion of Europe has begun, to determine whether our civilization is strong enough to survive.

Next day the newspapers were full of stories about "the first bombers over," the boys who had to smash the Nazi gun emplacements on the French coast to clear a way for the first invasion barges. Perhaps as Burgess looked through the Chicago papers, he noticed that the navigator of "Booby Trap 11," first Marauder plane to reach the targets, was a young lieutenant whose home address, on Chestnut Street, Chicago, was a stonesthrow from his own home at the Lake Shore Club. He may also have been interested to read that the young man, Carl F. Junge by name, "uses some navigating instruments of his own invention," and that "the other boys threaten to ask for a larger plane so that there will be room for all of Carl's gadgets." No one guessed that the navigator might some day be connected with the Handicraft Division of Burgess Battery Company; but even that in time would come to pass.

Later in the month came a letter from Betty in England, where total war had entered every home. Writing to a friend, Burgess relayed some of the British news:

> Betty says that her house has now been used as a factory for nearly two years; that the dropping of boxes on the floor has damaged the covering badly, and that pieces of metal have been worked into the cork linoleum. Her crew and their work have been inspected recently by the military authorities and apparently with their approval.
>
> She says her most recent dress was purchased in '39, and that all that can be claimed for her clothes now is that they furnish a covering.

Burgess was proud of his daughter, and of her husband; he was proud of the spirit of teamwork which, through better times and worse, had brought success to their marriage. Both his children had made happy marriages; and so, of course, had he, as he took pleasure in repeating, when Ida and he celebrated their anniversary, Sunday June 25:

> Forty-one years of married happiness, and, praise the Lord, we are as well as our years would justify.

"Our years" having now passed the milestone of three score and ten, he was willing to consider any added span of life as a bonus, which he would enjoy spending as usefully as he knew how. After the comment about his wedding anniversary, he continued:

> With Mr. Welton's support on business phases, I expect to concentrate on research and development. The Board reflects a decided trend toward this type of work.
>
> It appears that the stockholders are going to avail themselves of the partial liquidation plan adopted by the Company.
>
> Projects of development have already been planned; one which I have been carrying on as a personal matter is capillary phenomena and applications—to be transferred to Burgess Laboratories.
>
> This traces back to the first laboratory developments I made my year after graduation—1896. I hope to make this the first important project of new organization. If so it will be carrying out a demonstration of my firm belief that much of value lies buried away in old records.

Except for the special war project at the Elgin laboratory, the Burgess Laboratories had been virtually in retirement from 1938 to 1944. During this period some changes were made in the tax laws which cleared the way for stockholders to withdraw, if they so wished, without financial sacrifice. The Laboratories had enough cash for this retirement of stock, and the plan was put into effect in 1944. Burgess now owned over 90% of the outstanding stock of the Laboratories, and was free again to carry on research and development in his own way. He was no longer responsible to provide the earnings which many former stockholders needed for their livelihood. Then Mr. Welton was brought in, as Burgess wrote, to manage the "business phases."

At noon one day when Burgess went to lunch he took along with him a vice-president of Burgess-Manning Company, R. L. Leadbetter. They sat at the table till 3 o'clock, for Burgess was in reminiscent mood. He talked about his researches in electrolytic iron at Wisconsin

under the Carnegie grant, and pointed out the connection between those researches and the history of Burgess Laboratories, a history which he felt was still in the making. He recalled that late in 1908 he had written to President R. S. Woodward (Wisconsin '04) of the Carnegie Institution regarding a certain discovery made under the Carnegie grant and inquiring whether it would be permissible to take out a patent, thus making it worth while to develop the discovery commercially. The answer, which had come in a letter dated November 16, 1908, had not been encouraging. The stand of the Institution was that it should not permit the securing of patents by investigators, and that it should even "try to prevent other people from utilizing commercially the discoveries and inventions arrived at by such investigators." As pointed out in Chapter 13, such restrictions, high-minded in purpose as they might be, tended to reduce the likelihood of anyone benefiting from the research.

"That letter," said Burgess to Leadbetter, "changed the course of my life." He then told how he had realized that the way to make research pay its way was to conduct it without depending on public or semi-public institutions; then the right to secure patent protection for one's discoveries would not be open to question. Within less than two years after the Burgess-Woodward correspondence the Laboratories had come into being, and in the decade that followed, Burgess's dream of an independent research organization had been richly realized.

At this time Dr. Burgess maintained a small laboratory at 180 North Wabash Avenue, where he could carry on his own experiments, and sometimes he had some of the other technical men come in and carry on experiments under his supervision. This was done largely at his own expense. It was here that he worked on Typha, the Vibro-Tool, fishtail propellers, Shawinigan Black, and other projects. Much interesting work, however, was done in outside research laboratories, such as those of Wm. H. Bussey in Chicago and Dr. Joseph Razek in Philadelphia. Some important work at this time was done under the immediate direction of O. W. Storey. All in all, the summer of 1944 was an important time for the Laboratories and for their founder.

In the midst of all these activities, Burgess sometimes wondered how much longer he was going to stay on earth. Sooner or later he would have to make an exit. But that didn't bother him; he sometimes talked about it. On the last day of June 1944, when, in the name of the Burgess Battery Company, he accepted the Army and Navy "E" Award, he made a speech. Addressing Brigadier-General Edgar L. Clewell, who had conferred the "E," he said:

> When the time finally comes that I shall attempt to crash the Pearly Gates, and St. Peter asks for an account of my doings on earth, I shall answer—"My most important work was the making of electric batteries, spending over fifty years at it."

That night the entire speech was set down in the notebook. Much of it was devoted to sharing the credit with others—"the three hun-

dred stockholders, the nine directors, the fifty managers and the two thousand factory and office workers" who constituted the Burgess Battery Company. All these credits were to be kept in mind for due recital at the Pearly Gates.

Meanwhile a great deal remained to be done on earth. Enough irons were in the fire to keep C. F. Burgess busy for years. Perhaps he would even find time now to answer all his mail! Burgess, perhaps taking after his father, was a born letter-writer; but he was not the most ideal correspondent. A single letter, written or received, might start an exchange of ideas which *could* go on for years; often it did not go on, because writing seemed less important than doing.

If there was one type of letter he liked to write more than another, it was a letter of commendation. He believed in giving honor not only where it was due, but while it could be appreciated; as when he wrote on July 6, 1944 to C. E. Nelson, head of the Nelson Muffler Corporation, Stoughton, Wisconsin. Mr. Nelson, an acoustical engineer, had been an employee of the Laboratories and Burgess Battery Company for a number of years. When the Battery Company decided, about 1938, to give up its Madison operations, Nelson, with several other Burgess Battery Company men, acquired certain parts of the business and established the Nelson Muffler Corporation at Stoughton. Nelson was aided in founding this business by liberal terms offered by the Battery Company, in line with the policy established by Burgess and referred to in an earlier chapter. The Nelson business grew and prospered, and Burgess was proud of the showing that it made. In his letter of July 6 he said, in part:

> Mr. Manning has shown me the four annual statements of your company. I find them very interesting, being a complete story of what can be done in starting and operating successfully a new business. From it could be made a story useful as a guide to others who are interested in solving a question uppermost in the public mind: "What chance has a little business in these troublesome days?"
>
> I shall always remember your answer to the question as to how your company began making money from scratch. Your answer was to the effect that the three leading officers of the company actually did the physical work of loading the cars with your first shipments. The continuation of this policy is well reflected in the table at the bottom of page 9 of your report of August 31, 1943. For example, your selling, administrative and general expense is less than eight percent of your gross sales. I do not know of any other corporation that can equal this record.
>
> Strange as it may seem, I take a great deal of pride in the fact that after we had decided that a certain line of product was unprofitable to us, you took hold of it and made an outstanding success.

Whenever Burgess gave advice to young men starting in business, he warned them to keep their overhead expenses low. He knew that many enterprises fail because their sponsors indulge in unwise expenditures, often simply to put on "a big front." Hence his interest in Nelson's ability to keep his overhead down. The overhead expenses

of the Burgess companies were kept low, partly because managerial salaries, including that of Burgess himself, were low in comparison with those paid by other similar companies.

On Sunday June 9, Burgess drove out to Antioch, Illinois. His notebook does not tell us what he did there, but it does mention an incident of the homeward trip:

> On way south, at lunch room near Libertyville, saw biggest man—7′ 1″ tall. What an advertisement he might be.

Trust "C. F." for figuring out a job for a man handicapped by excessive size! Possibly he was thinking of the Libertyville giant as an added attraction for the handicraft store.

Bing Crosby was commended in a notebook entry on August 5:

> Crosby Brothers, Bing and Bob, have set up their own research foundation—searching for and appraising worth-while ideas. Has cooperation of Cal. Tech. This is a good idea for technical schools to foster.

Burgess was proud of his brothers, George and Kenneth, and on September 7, 1944, he was pleased to be able to record an official honor which had come to one of them:

> Went to office of Admiral Carpender, of Great Lakes, to attend the citation Honors to Kenneth. It was for distinguished service to Navy.
>
> He headed a committee that made extensive investigation and report. From the admiral's statement—98% of recommendations were adopted, much to benefit of Navy.
>
> I am proud of my "little brother," who has richly deserved this honor.

The next entry in the book provides an amusing change of scene. He has read a newspaper article, and boils it down to about a dozen words:

> Article from Chicago Journal of Commerce, re. "how executives of 65 or more can gracefully retire before being kicked out."

Though it was a topic which had occupied his mind for a long time, reading of the article made no difference to his plans. He knew what he intended to do, and when. But he hadn't retired yet, and he continued to be as busy as ever. From his notebook we learn that he spent an entire morning in his Chicago office preparing for a luncheon at the University Club, which he was giving in honor of his old friend Dr. Lee de Forest. This was on Tuesday September 26. Among those present were President Henry T. Heald of the Illinois Institute of Technology, Dr. Jens Christian Bay of the John Crerar Library, and several officials and friends of the Burgess companies. Burgess made some notes about de Forest:

> He gave an interesting talk on his early experiments in Chicago; and on request from me recalled his narrow escape from a prison sentence in Atlanta—being charged with using the mails to defraud by predicting that by use of his equipment we would one day be able to talk by voice through the air to Europe.
>
> He is so far from being a boastful talker that he fails to do himself justice, and does not attempt to dramatize his experience. An exciting novel could result from his life's history.

The luncheon had been arranged at short notice, and of eighteen guests invited only fifteen were available. Burgess notes that the fifteen had a good time:

> This proved to be a successful gathering, because it was a group of interesting people, with diverse lines of interest, the kind that seldom gets together; and especially because of having this noted inventor as a guest.

Several hours after the luncheon, Burgess visited another inventor, ten years older than Lee de Forest, but still going strong. This was Henry H. Hardinge, ardent proponent of the land-tax principles advocated by Henry George. "H.H.H.", although an American of Canadian birth, evidently seemed to Burgess like a typical Yankee. Describing the interview, which took place in Hardinge's experimental model shop at 1133 W. Newport Avenue, Chicago, Burgess writes:

> H. H. H. is small man in small shop filled to overflowing with machines, metal supplies, models, etc. A remarkable old-type Yankee inventor. 82 years old, but lively and smart as they make them.
>
> He was working at a machine lathe, and proceeded to show me two attachments he has invented, one a feeding gauge, the other a tool-holder, both of which seemed to me new and meritorious. If so, we ought to have them in our own shops, and I propose getting them when priorities permit.
>
> Hardinge is a man of talent as inventor and mechanic, and may be useful to us in future developments.

In Burgess's mind, one thing about the future was as clear as crystal—it would be full of developments. Developments would call for man-power; and in the field of inventive genius, man-power had no age-limits.

Sometimes on Sunday Burgess would go downtown to spend a few hours in his office, or to "putter around" in his laboratory; but on October 1, the Sunday following the deForest luncheon, he stayed at home, "talking over various projects" with Dr. Joseph Razek, consulting physicist from Philadelphia, "and battling with a cold, or hay fever." Perhaps it was a cold; anyhow, the memorandum of Tuesday October 3 is as follows:

> My voice gave out completely, so I went to apartment where I went to bed, and remained there. The first day off on account of illness for several years.

Burgess seldom admitted that he was ill. Indeed he had enjoyed better than average health for many years. But to lose one's voice entirely is, to say the least, inconvenient; and he was doubtless wise to do a little resting. Resting—a relatively new experience—seemed to agree with him; and he continued the note just quoted by saying:

> Nevertheless, I am finding that with quiet, and little interruption, I can do better planning and thinking; and wonder if staying away from office at irregular intervals might not be wise.

Later in the month he stayed away from the office, not exactly to rest, but to spend an enjoyable, busy day up in Madison, where he met a number of old friends, animate and inanimate; but let him tell it in his own words:

> Friday October 20. At University, 9 A. M. No one at Chemical Engineering Building. Wandered through Electrical Lab., saw a lot of old friends of mine—dynamos, motors, transformers, instrument stands, lamp banks—that I used 50 years ago. Talked with the machinist who showed me around. This is a mid-semester week—no classes.
>
> Called on Eddie Maurer—same old place. He is 76, and on semi-retired list. Delightful visit.
>
> Called at Biology Building trying to see Dr. Birge, but he was out—on an errand.
>
> Maurer called up, asking me to have lunch with him, Turneaure and Watts; which I did, and had a good time reviewing old times.
>
> Then called on Doctor Birge—92—still at it. We had a good visit, and he seemed to enjoy it as much as I did. Asked me to come again.

All in all, it was an exhilarating experience. And it must have been encouraging. Here they were: Maurer, five years older than Burgess, still in the same old place and only "semi" retired. Turneaure, seven years older, and still going full blast. Watts, also about seven years older, technically retired, but active every day in his research laboratory; and Birge —*he* rates an individual paragraph.

Edward Asahel Birge, eminent zoologist and limnologist was twenty-three years older than Burgess. (He was 93; the notebook entry was a year short). He had started teaching at Wisconsin when Burgess was only two, and had been Dean of the College of Letters and Science from 1891 to 1919. He had served the University as Acting President, 1900-1903, and as President 1918-1925. At the turn of the century he had backed Dugald Jackson, John Butler Johnson, and Magnus Swenson, in their efforts to establish technical training in chemical engineering. Perhaps Burgess remembered how his old classmates Vroman Mason and Edith Lyon, when they wrote the Class Prophecy of 1895, had described a future imaginary book dedicated "to the late Dr. Birge." Professor Birge was then only 44, but his hair was already greying, and to the Class of '95 he seemed extremely old. Now, about half a century later, Burgess had found him "still at it"; nominally living in retirement, actually keeping

in close touch with all University happenings, sports events included, and sometimes speaking to delighted audiences. Here indeed was an old age crowned with continued usefulness. No wonder Burgess almost envied Birge.

He too must continue to be useful, even if he lives as long as the venerable zoologist. With this end in view, he must make careful plans. On October 30 he notes:

> I am determined to devote most of my time from now on to Burgess Laboratories interests. Am hoping, above all other business interests, that Labs will become a leading factor in development work.
>
> Have enough help to make a good start . . . Now up to me to organize and maintain enthusiasm.

Like a man preparing to write the final chapter of a story, Burgess prepared to outline what might well prove to be the final chapter of his career.

40.

The Final Months 1944-1945

"TOMORROW it is my intention to resign as director of Burgess Battery Co., which implies ceasing as Chairman of the Board and therefore as an employee of the company. I am taking this step because as founder and directing head of C. F. Burgess Laboratories ever since its incorporation in 1910, I wish to devote my main efforts to carrying on the work for which that organization was organized." So wrote C. F. Burgess in his notebook on Sunday November 19, 1944.

The resignation did not take place on Monday; the notes for that day indicate other activities, and the directing of a letter to President Sidney D. Kirkpatrick of The Electrochemical Society, "making certain suggestions as to the future conduct of that organization." It was in this letter that Burgess spoke of his deep affection for the society; on the eve of a day of high decision, he was taking time to serve a cause he loved. Then Tuesday came, November 21st:

> This has been a momentous day—three directors meetings—Burgess Battery, Burgess Manning, Burgess Cellulose—at the first of which I submitted my resignation as director and chairman.
>
> It was a solemn occasion for me—could hardly suppress a tear, as at the end of a 27-year struggle and a successful one, I am relinquishing my technical leadership.
>
> Ben Reynolds tendered a resolution of regret, and Dan Hirtle spoke in a sincere manner in words which I shall remember, especially when he said he did not know how to break the news to the younger men who have looked to me for guidance.

He then goes on to say he told the Board that he was as interested as ever in the Battery Company, and would continue his advisory association with that company. Furthermore, that he would strive to bring C. F. Burgess Laboratories, Inc., "back into its position of leadership." It had functioned now 34 years as a research organization *paying its own way.* Now, "with greatly shrunken personnel," and in the face of new and difficult conditions, he would try to make it as effective as before; and, he continued:

> In this effort the good will and assistance of the family of companies which it has created will be of great value—and there is no reason why a continued reciprocation of assistance may not benefit these companies.

He pointed with pride to a number of companies "now in successful operation whose origin can be traced to Burgess Laboratories." Presumably the ones he had in mind were:

Burgess Battery Company
Burgess Cellulose Company
Burgess-Manning Company
Burgess-Parr Company
Burgess Products Company, Ltd.
Wood Conversion Company
Research Products Corporation
Nelson Muffler Corporation
Microswitch Corporation
Burgess Zeolite Company, Ltd.

As we have seen, some members of this "family of companies" were fully independent of their parent. But independence did not mean indifference; the good will of which Burgess spoke was a real and lasting bond.

A few days after the events just recorded, a graceful editorial tribute to Dr. Burgess appeared in the *Freeport Journal-Standard.* It was written by Donald L. Breed, president and editor of the paper, and was entitled "Change, but Not Retirement." It stated in part:

> He is doing what every elder statesman, either of politics or industry, should aspire to do at this time of life. He is clearing his desk of those things which others can do and will do well, and he is devoting himself to supplying that creative imagination of which he has been a fountain-head, and without which no industrial enterprise, no human project, can long continue to exist.

Burgess was pleased to have his fateful step described in words so happy and understanding, and he promptly sent Mr. Breed a note of appreciation. The reference to things "which others can do and will do well" reminded him that some things had already been done well by others, a fact referred to in his notebook on November 23, describing a conference at the office:

> I cited the fact that starting from scratch three years ago, there was developed a new line of special batteries now being made at a monthly profit of between $3000 and $4000. We agreed that greatest credit is due to Jack for his ingenuity, management in face of difficulties, courage and perseverance in dealing with government bureaus.

Explaining matters in a letter to Dr. Oliver Watts, Burgess said, "I have voluntarily placed myself on the emeritus basis—at least as far as the Burgess Battery Company is concerned." But he was never to feel that the change in his status with the company had resulted in cutting him adrift. Perhaps in some ways it had drawn him closer. Let us see his notebook entry of Tuesday December 19:

> As visitor I attended meeting of B. B. Co. After routine matters I was startled to find a conspiracy on foot to award me an

> engraved plaque testifying to the importance of the service I have rendered the Battery Co. Storey made an eloquent presentation speech, and I am deeply touched by this testimonial.
>
> I accepted, saying that a purpose I had in resigning was to carry out the philosophy of Burgess Laboratories to do things in a different and better way than is prescribed by custom.
>
> I had noticed the universal custom of the business executive hanging on until the undertaker carries him away, and I have decided that this would not happen—but I am going to sit in the gallery, and when I see something going against rules and traditions I will be able to pull someone's ears.
>
> I believe this is the outstanding honor that has come to me.

Then came a typical pre-Christmas week, with many departures from normal routine; and then a peaceful Christmas Eve on Sunday:

> This Christmas Eve, Ida and I spent alone, Jack and his family being in Madison at the celebration tomorrow of golden wedding anniversary of Mr. and Mrs. Thomas (Parents of Mrs. Jackson Burgess).
>
> We agreed that we had enjoyed this two-party reminiscing evening, accompanied by the fifty-some Christmas greetings from our friends, mostly old.
>
> The term "Merry" seems to us insincere and not fitting, when most other people are anxiously waiting messages from their family members at the battle front. The war news is far from good. . . . How little we, over here, are sacrificing, with all our comforts, as compared with the supreme sacrifice "over there."

Christmas Day also was spent quietly. The notebook mentions "Usual formality, opening our presents," and the pleasure derived by Charles and Ida from a series of long-distance telephone conversations with relatives and friends; the highlight was a call from the Eric Cottons in England, and no doubt Betty remembered to add a "Happy Birthday" for her mother, born two days after Christmas. The Jackson Burgess family was back from Madison in time for a birthday dinner on the 27th. Then the notebook tells about another Sunday, the closing day of 1944:

> Had the usual pleasant and quiet day with Ida. A dark smoky day outside.
>
> About half the time spent in writing paper on Reminiscences of Electrochemistry, and Predictions.
>
> Ida and I have a solemn feeling—a really depressing situation which confronts all of us, here and abroad.
>
> We listened to "One Man's Family," a really remarkable dramatization of ideal home and family life. Wish the spirit of this could be brought to every family; but it cannot. Ida and I listening to this almost felt as though we were with this imaginary family as old people, quietly looking on. We realized that we *were* old people, quite correctly, but our family scattered and out of reach.

In the final hours of 1944, Burgess found time for a brief glance at the past, a hopeful look into the future:

> I feel rather proud of the accomplishments of past years, and particularly of '44. Being free of all restraint from objecting

> stockholders, and having shed the business responsibilities of B. B. management, I feel a great relief and enthusiasm for the future.
>
> This may be foolish, to act as though I had many years ahead—but it is interesting, nevertheless.

The notes made on New Year's Day 1945 start out boldly with detailed plans for a better, if not bigger, research organization:

> What are some of the matters requiring early attention? The one of major importance is planning for and strengthening Burgess Laboratories.

Then comes a review of the available personnel, and the methods of getting and handling business. After a number of paragraphs, a sudden change of subject:

> Curious observation I am making—in writing above notes my mind is in hazy condition, words do not come, nor ideas.
>
> I took streetcar and subway down to the Loop and to my office and lab., where I spent a couple of hours. It is a very cold day; the building got too cold for comfort, so I returned to apartment. My wheels seem to be working better.

Burgess was never allowed to forget that his birthday almost coincided with the birthday of the year. Here is his note of January 5, 1945:

> When I passed the reception desk, all the girls in outer office sang "Happy Birthday"; and roses from A. R. Welton, Manning and Storey, and a triangle-shaped package from Dan (Hirtle), all reminded me that this is my 72nd. Had many greetings and handshakes.
>
> It was a good day, most of it spent with Dan. We went over the whole Battery situation, and believe we made real progress.
>
> I had a most enjoyable and I believe profitable day. Certainly a good way to begin another year.

Another year indeed, and a growing list of "things to do" promised that it would be a very busy year. Among engagements already on the docket were talks with A. R. Welton, new president of Burgess Laboratories, a paper to be read at the Museum of Science and Industry, a day or more of reunion with his old friend Harold J. Wrape of St. Louis, and —perhaps most important—a trip to Boston for an 80th birthday dinner in honor of his beloved mentor, Professor Dugald C. Jackson. All these, and much beside, crowded into the first few weeks of 1945.

The paper was the one Burgess had started to write in the concluding hours of the old year. It was prepared for the "Industrial Development and Electrochemical Conference," sponsored by the Chicago section of The Electrochemical Society, held in Chicago at the Museum of Science and Industry on January 19. Burgess had been glad to learn where the conference was to meet, because the purposes of the museum, to which he had contributed with both money and acoustic displays, were very close to his heart. Founded in 1926 by Julius Rosenwald, the avowed aim of

the institution was "to portray the historic and present-day developments of scientific knowledge, and the application of this knowledge to industrial progress and to the uses of man."

The meeting, fairly well attended considering the weather and wartime travel restrictions, was held in the daytime. Following an address by his friend Sidney Kirkpatrick, President of The Electrochemical Society, Burgess rose and proceeded to read his paper. He called it "Reminiscences and Future Prospects in Electrochemistry," and a friendly audience listened with interest as he told of his early experiences at Wisconsin, of the pioneer work of Dugald C. Jackson, and of the years spent by Burgess and his colleagues in the study and production of electrolytic iron. Then, several times in close succession, he hesitated. Each time this happened he seemed bewildered, and his friends began to wonder what was the matter. As one of them said, "He seemed at a loss for words, though he had his manuscript before him." Then came a pause. Burgess stood very still, and silent. He could not go on. Forlorn, he turned and walked to the seat that awaited him, next to President Kirkpatrick. In a gesture of encouragement, Kirkpatrick put his arm around the tired man's shoulder; for Burgess had murmured, as he sat down, "I am very tried." He would not admit that he was ill; indeed, by next morning he was in his office, chatting with his Canadian friend Dr. A. F. G. Cadenhead, trying to make light of the Museum incident.

Before a week had passed, the truth came out. Two or three days before the Museum meeting, Burgess had met with an accident. Getting off a streetcar he had slipped and fallen on the ice; he had received some bad bruises, and although he did not say so, perhaps had suffered other injuries. If his friends had known about it, they would have been unwilling to let him appear at the meeting. That is why he had suffered his pains in silence.

A few days later, some friends brought to his apartment their little granddaughter, a baby less than a year old. There had been some question as to the advisability of bringing the child, because she was usually afraid of strangers, especially of men. But she was not afraid of Dr. Burgess. She went to him without hesitation. Recalling the incident her grandfather said:

> She took to him. He went on his hands and knees on the floor to play with her. And he wasn't showing off to *us*. He *liked* to play with the baby; and she just naturally liked to play with him.

This friend of little children was a man of seventy-two, by no means used to going on all fours, and still feeling the effects of a painful and dangerous fall.

By the beginning of February, when Harold Wrape got to Chicago for a brief reunion, Burgess was feeling himself again. The two men spent an entire afternoon together, and after dinner they talked again till midnight. They talked about the old days of the American Carbon & Battery Company, and of Burgess's warm regard for Harold's father, president of the company. Henry Wrape had been a blunt, outspoken, positive sort of man, who made dogmatic statements in the heat of argument, and

then joined with the others when they laughed. Burgess recalled Henry Wrape's kindness at the time of the fire in 1915. They spoke also of Carl Hambuechen and of his real and faithful service to them all. Not forgotten was the sinister Samuel Stern, who did not seem so sinister as in the long ago; and there was Conrad Hubert, now remembered less as an adversary than as a man who had done much to popularize the flashlight, and, incidentally, as a man who had bestowed most of his great wealth in charity. It was pleasant, looking backward through the mellowing haze of time. Next day, at train time, Burgess announced that he would see his friend to the station. Wrape smiled and said, "You're too dern old to walk"; but Burgess insisted on walking all the way to the Union Depot. It was a cold, cold day, Friday February 2.

The list of things to do was longer than ever; and there was still the Dugald C. Jackson dinner, scheduled for February 13th. Burgess was used to hearing people credit their success to him; now he was eager to acknowledge his deep indebtedness to Dugald Jackson. "Nothing short of an earthquake," he said, "will keep me away." Time and time again through the years he had expressed his thanks in writing; now he would be able to express it by word of mouth—a half a century of gratitude.

On Tuesday February 6, Chester H. Thordarson died. Burgess had referred to him as a friend who had demonstrated unusual genius and proved to be outstandingly useful. His exit was felt as a deep personal loss, but Burgess was glad to have been able to cooperate with him helpfully in his closing years. As we have seen, this desire to cooperate was characteristic. It was mentioned in a message received at about this time from Edgar J. McEachron, of the Marathon Battery Co., Wausau, Wisconsin. This was one of several in which Mr. McEachron thanked Burgess Battery Co. for wartime aid, given freely to competitors, so that they would be in better condition to meet government specifications for dry cells. In one of his letters Mr. McEachron said, "We feel the battery industry in general owes you a debt of gratitude for your splendid gesture in opening up your technical knowledge to the industry." Early in February Burgess wrote:

> There is probably a mutual feeling between your company and ours that neither of us has suffered from cooperation and exchange of ideas. I am sure that the welfare of your company is an asset rather than a liability to ours.

"Live and let live" was not enough for Burgess. In his mind the spirit of the practical old slogan was softened, and strengthened, by recollection of the Golden Rule.

Looking through the mass of papers on his desk, he realized that in spite of what he called his emeritus position, the daily routine still looked like "business as usual." This is really what he wanted. To him it seemed natural to be up and doing, and as long as he was up he would be doing, even it it meant staying late at the office, as he did on Wednesday February 7, after writing the Marathon letter. President Welton looked in: "Everyone else has gone home; don't you think you'd better call it a

day?" Dr. Burgess didn't seem to think so. "No, thanks, I think I'll stay here a while and work." Then a smiling "Good night."

Early Thursday morning, in his apartment at the Lake Shore Club, Burgess rose quietly, so as not to awaken his wife, and telephoned his physician. He was ill, and he knew it; perhaps from a heart attack. While waiting for the doctor he dressed himself. Then the doctor came, and Mrs. Burgess had to be told. Prompt action was taken, and an hour or so later, when the office people reported for work, they learned that "C. F." was in the Presbyterian Hospital, where he might have to stay for several weeks, taking a much-needed rest. To many of them the news came as a distinct surprise, because Dr. Burgess's physical condition had seemed to be good. Others, who remembered the Museum incident, were not so surprised; especially those who knew about the fall on the ice, with its bruises and possibly more serious injuries.

Regardless of all else, the first order of business was for Burgess to get better. That, he insisted, was going to be easy. Only a few hours after entering the hospital, he telephoned the office and talked to his secretary; the word soon got around that all he needed was a rest. The doctors said that this rest would have to be complete, and that it would have to extend through several weeks. But they couldn't impress this thought on C. F. Burgess. He was inclined to be as obstreporous as he had admitted being in his early college days. He took the stand that this hospital business was being overdone, and that he could win back his strength in a day or so without staying in bed. He was by no means an easy patient; but other men in similar conditions had been similarly unreasonable, and the doctors and nurses took him in their stride. What made the experience doubly hard for Burgess was the fact that his mind was so full of things to be done. By February 12 he wanted to be out of the hospital and on his way east to the D. C. Jackson dinner; that was important. Less important matters, too, kept coming up in his mind. One of these he mentioned when his son came to see him; it was the matter of his collar buttons. They had been left in his shirt. They were not ordinary buttons, made of mere gold or platinum; they were made of Illium. The men at the Burgess-Parr plant had made them specially for him, and had put loving care into the polishing of them. He counted them among his treasures, and he didn't want them to get lost. Jackson Burgess promised to take care of them for him.

Meanwhile, according to the doctors, the condition of their patient was not unduly critical. This statement had a reassuring sound; but it was only another way of saying that the condition, while it might be worse, *was* critical. It was a week of doubts and conjectures and hopes, all blended in an anxious question-mark. Early on the morning of Tuesday February 13 the answer came, suddenly. Charles Frederick Burgess, who had longed to spend this day traveling eastward, to render thanks to an earthly benefactor, had been forced to submit to a change in traveling orders. On more than one occasion, half smiling, half in earnest, he had talked of Pearly Gates. And now? Perhaps his father's words came back to him; words of the distant past, but now so near:

> In parting with the things of this world we do so that we may open our eyes to a brighter, more brilliant career, beyond the veil that hides the future from our earthly eyes.

The same belief, affirmed in other words, seemed to run through the service of memorial held on Thursday February 15 at St. James' Episcopal Church in Chicago. The theme of the Scriptural readings, selected by the Rector, Dr. Duncan Hodge Browne, was a theme of life renewed. Earthly tribute was taken from *Ecclesiasticus,* opening with the time-honored words:

> Now let us praise famous men,
> And our fathers that begat us;
> The Lord manifested in them great glory,
> Even His mighty power from the beginning.

Burgess was missed in many places and in many ways; most keenly and completely by his wife. And yet, though first to bear the shock, and hardest hit by the blow, Ida alone was really well prepared. Years earlier, foreseeing what might happen, she had written:

> Some day either he or I will face going on alone. It wouldn't be living for me, but I hope that if I should be the one who is left behind for a while, I could find, in the bravery and courage he has taught me, strength to go on.

Courage remained, but very little strength. Mrs. Burgess, for years a partial invalid, found that the going on was far from easy. She had been willing, if need be, to stay behind for a while; but as the months went on, she longed to be united with her loved one. December came, with thoughts of other Decembers, and of what they had meant to the little family. Then Ida said "If only I could spend this Christmas with Charlie." Her wish was granted. And when she, too, had gone, her children remembered some words about herself and Charlie which she had written especially for them:

> Whatever comes now, we have had this, and with it all the years that went before—years of work and love and happiness, of shared anxiety and of shared joy. It has been a rich, full life. Whatever the future holds for either of us, we have had this.

Without its founder to direct its activities under his brave new program, C. F. Burgess Laboratories, Inc., began to seem like a body without a soul. To keep it going would be a full-time job for someone—someone closely resembling Burgess. Loyal as they might be to his ideals, his survivors felt unable to continue the Laboratories as he had planned, especially in view of the tax situation, which was still very difficult. So, in October 1945, the corporation was dissolved. Some of its main projects, including the capillary electrometer, were inherited by friendly associates; and of course, no interruption was contemplated to the research work of the Burgess Battery Company in its own field, or of similar

work normally carried on by other Burgess companies. "Burgess" would still be a synonym for research and development.

* * * *

We now know that Charles F. Burgess was born, lived, worked and died. We know that he was inspired with ambition by one admirable woman, his mother; that he was given enthusiastic and never-failing support by another admirable woman, his wife. It might seem that this is the end of the story. But a man's works live after him; and the works of Burgess live on in a very real way, influencing the daily lives of thousands. In the fields of education, science and industry; in the field of human relations, remembering always the hopes and problems of youth; in the field of research for truth, and the development of truth for the use of mankind—in all these fields of human thought and effort—Burgess inspired others, and others carry on. A story well begun is never ended.

TECHNICAL APPENDIX

OLIVER W. STOREY

Section I

INTRODUCTION

THE appendix of which this is the first section describes in greater detail the personal technical accomplishments of Dr. Burgess largely as they are disclosed in his published articles and in patents issued to him. Most of the material supplements that appearing in Mr. McQueen's biography. A section on education is included because Burgess was concerned primarily with technical education.

Each of the sections into which this appendix is divided is devoted to a particular technical subject. The lines of demarcation between them could not always be drawn clearly, some overlapping being necessary to make each section complete in itself. Whenever the particular subject is discussed or referred to in the biography, reference is made to the pertinent chapter.

In the accompanying bibliography the list of Burgess U. S. patents is complete and the list of his publications is believed to be substantially so. In addition there are listed the publications by and the patents issued to others which are referred to. Many of these latter publications and patents were based on work which was supervised by Burgess and these are referred to whenever such published work was closely related to or was a part of the particular Burgess activity being described. In addition there are some references to unpublished material such as the technical reports of the Burgess Laboratories, Burgess's personal and business correspondence and drafts of his unpublished talks. These references to unpublished material have been kept to a minimum though a large volume of material was available.

The writer, who enrolled as a freshman in the Chemical Engineering course at the University of Wisconsin in 1906 and was thereafter almost continually associated with Burgess until his death in 1945, has drawn upon his personal knowledge a number of times in presenting the material in this appendix.

Further information about the accomplishments of the several companies whose activities were directed by Burgess supplementing the information given in the biography (particularly in Chapters 20, 21, 22, 23, 26, 29, 30, 31, 32, 33, 34 and 37) is found in talks given when he was awarded the Perkin medal in 1932[248,33] (Chapter 26) and the Acheson medal in 1942[238,239,86] (Chapter 37). See also his obituary in the *Transactions of The Electrochemical Society*.[249] Reference may also be made to articles by Lyman Anson,[250] R. M. Yoder,[251] and O. W. Storey,[252] which tell more about his personality.

Section II

BATTERIES

BURGESS'S work on both secondary and primary batteries, battery raw materials, battery-making equipment and processes and battery accessories, such as flashlight cases, is included in this section.

When Burgess was an undergraduate in electrical engineering at the University of Wisconsin (Chapter 2) all of the applied electrochemistry was taught in that department in one course of study divided into (a) Primary and Secondary Batteries and (b) Electrolysis and Electrometallurgy. The subject of "batteries" thus was relatively important though the modern dry cell had not yet become of much commercial significance. However, primary and secondary cells still were of importance to the electrical engineer because central-station electrical energy was available only in limited areas. Such wired power as was available usually was direct current and this did not have the flexibility of the alternating current that was to succeed it. It was the period during which electric power generated by electro-magnetic machinery was replacing that generated by primary batteries and the use of the secondary or storage battery was being expanded rapidly. The use of the type of primary battery required for generating sizable amounts of power was declining rapidly but it was being succeeded by another type of primary battery, the new dry cell, a convenient source of packaged electricity destined to grow into a major electrical industry.

The records left by Burgess showed his great interest in both primary and secondary batteries. He studied their constructions, performances, uses, and methods and cost of production. He accumulated catalogs and whatever literature there was available. In later years he was called on often to discuss dry cells before many groups such as the technical employees and salesmen of the Burgess companies, and users of batteries. He occasionally referred to this early period and credited Prof. Dugald C. Jackson with giving him encouragement in small cell work. He also referred to his early work on the standard cell and chloride of silver cell. In his notes and correspondence of about 1898 he referred to a successful aluminum cell that he had devised. This may have been the "testing" battery that is referred to in Chapter 5. Significantly an aluminum cell was never sold by any of the Burgess enterprises during his lifetime.

Burgess did devote much time prior to 1905 to the study of stor-

age batteries and in 1899 wrote a paper on the "Changes of Electromotive Force within the Secondary Cell."[80] It was at this time that the demand for storage batteries was increasing rapidly. When Burgess became interested in the development of a fused-salt type aluminum rectifier useful for charging storage batteries, as told in the section on Electrochemical Devices, he intensified his storage battery studies. A number of students carried on thesis work and he did some testing and investigational work for manufacturers of storage batteries. Of interest is the comment of the Porter Battery Company in a letter dated January 29, 1902 on tests made for it: "The test is very complete and the detail is most satisfactory. It is the most comprehensive report we have ever received, and we have to thank you very much for your careful attention to details."

In 1904, Burgess, as a member of the Jury of Awards on electrochemical and electrometallurgical exhibits at the St. Louis Exposition, (Chapter 12) had the opportunity of getting detailed information about the battery progress that had been made in America and Europe. In his report on the exhibits made to the American Electrochemical Society[75] in 1905 he gave a detailed account of the battery exhibit (Chapter 12) which indicated his keen interest in the subject.

Though Burgess was qualified as a storage battery expert his enthusiasm for such batteries was much less than it was for small primary batteries and particularly the dry cell. The greater portability of the dry cell, the opportunity of making small units and the apparently greater opportunities for improving its performance appealed strongly to him. It is not surprising, therefore, that after he became closely associated with a company manufacturing dry cells in 1907 he lost most of the interest he had had in storage batteries, never to regain it. When, in 1921, Major Carl Kinsley tried to interest him in making storage batteries, he replied on May 24: "I have had extensive experience in storage battery matters and this has led to our company committing itself to excluding storage batteries from our line of production."

In 1900 Burgess had one of his students, A. A. Radtke, run discharge tests on the various makes of 6-inch dry cells (Chapter 7) then on the market. This work, presented as a thesis[240] was later incorporated by Burgess into an article published early in 1902 on "The Dry Cell."[81] Burgess often referred to this article as the first published technical article on dry cells.

At about this time he undoubtedly learned something of the practical side of dry cell manufacture when Carl Hambuechen '99 returned the next year to pursue graduate work under Burgess and then continue in his employ following a year's employment by Western Electric Company in Chicago, part of which was spent in the production of 6-inch dry cells.

Although Burgess kept himself informed about the progress of dry cell manufacture and also did some testing of cells after publishing the 1902 article, he was not again actively engaged in work in this field until he became interested in rescuing the French Battery and

Carbon Company from its poor-quality predicament starting late in 1907 (Chapter 21).

As related in Chapter 21, Burgess, soon after becoming associated with the French Company, advocated getting out a series of bulletins on dry cells. The earliest numbers were written by himself. In the first number he wrote:

> There are many delusions about dry cells. One is that a manufacturer has valuable *secrets;* many a man has been deluded into the belief that he is buying a good dry cell, and when he has discovered his mistake he has been further deluded into thinking that there are no *good* dry cells. . . . The day of secret formulae and *secret* processes is past and the manufacturer who is not willing to tell his customer how, or of what material his product is made, is usually trying to conceal something he is not proud of.

In 1909 he wrote a report to the French Company in which he pointed out that the theoretical possibility of improvement of dry cells "is great" and that: "It is absolutely necessary, therefore, that a battery manufacturer who wishes to remain in the field shall devote a good deal of attention to keeping up with progress." He also pointed out that the advent of the Tungsten lamp, taking one-fourth of the amount of energy consumed by carbon filament lamps, was of importance to the dry cell industry and "an enormous use of dry batteries can, therefore, be expected for illuminating purposes alone, as there are many places where battery illumination is much cheaper than by other methods." Among the reasons justifying his advocacy of a publicity policy as opposed to a policy of secrecy about dry cell manufacture is the following one which is of interest to the scientist: "The disclosure of the unsolved problems of battery construction will result in a stimulation of scientific investigation, the progressive manufacturers who are most prompt to benefit by such results will be the ones who will be the most successful." He then went on to state that he was going to follow that policy in the future, and true to his word, he and Hambuechen presented a paper that same year to the American Electrochemical Society[82] in which certain characteristics of dry cells are described. It was translated and published the following year in Germany.[83]

After Burgess had improved the quality of the French 6-inch cell so that it at least was equal to the best competitive cell an unexpected obstacle was encountered in marketing them at a competitive price, namely, the failure of most purchasers to make reliable comparative tests of competitive cells, and furthermore, the absence of any accepted standard tests. Much of the testing that was done, and that applied to many of the manufacturers, was of the crudest and the results were unreliable. The seller of a quality cell often found it difficult to convince the purchaser. Burgess soon advocated the establishment of standard test methods and specifications by the American Electrochemical Society. That Society appointed a committee for that purpose in 1909 consisting of C. F. Burgess, Chairman, J. W. Brown, F. H. Loveridge, and C. H. Sharp. The committee made its first report, which included flashlight cell tests,

to the Society in 1912.[84] This report proved to be of much value to the industry and to users as foreseen by Burgess. As stated in Chapter 21 the U. S. Bureau of Standards shortly afterward took over the functions of this committee. However, when the demand for radio batteries began to mount rapidly in the early 20's the committee was reactivated under Burgess with C. A. Gillingham and Dr. G. W. Vinal as the other members. It submitted a report to the Society on the "Standardization of Tests for Dry Cells Used in Radio Receiving Sets."[85]

For many years Burgess was chairman of the Technical Committee on Batteries of the American Electrochemical Society, beginning with its first appointment in 1909. The 1936 report to the Society reviews its accomplishments during the 27 elapsed years.[88]

In 1912 two more papers on dry cells that originated in Burgess's Laboratories were published by the American Electrochemical Society, one by Carl Hambuechen on the "Performance of Dry Cells"[241] and the second by Hambuechen with O. E. Ruhoff on the "Physical and Chemical Data on Dry Cells and Dry Cell Material."[242] These papers refer specifically to the 6-inch cell and were published in furtherance of Burgess's "anti-secrecy" policy. In the next year the Burgess Laboratories started the manufacture of miniature cells in earnest and production increased rapidly. It was natural, therefore, that the next technical paper by Burgess should be devoted to the characteristics of such cells.[87]

The first patent to Burgess on a dry cell was issued (with Hambuechen as co-patentee) in 1912[112] and related specifically to improvements in the 6-inch cell construction though applicable in part to miniature cells. One of the improvements was the paraffining of the entire carbon electrode instead of only the end to be capped as was the practice up to that time.

The story of Burgess's early miniature cell work is told in Chapter 21 and particularly the dramatic story leading to the discovery that impalpable graphite gave superior cell performance. Burgess[86] also told this story at the presentation to him of the Acheson Medal in 1942. At this same event, G. W. Heise, during his recitation of Burgess's accomplishments, explained the importance of this discovery when he said:

> Burgess's use of impalpable Acheson graphite led to new concepts of the effect of fineness of mix ingredients on cell performance. The resulting improvement was one of the factors which made possible the substitution of manganese ore for the "artificial" or chemical manganese dioxide, largely imported from Germany before the first World War, and previously believed essential in certain types of cells.

The five years of experimental and development work which preceded the impalpable graphite discovery laid the basis for it and other improvements made prior to the incorporating of Burgess Battery Company in 1917 and used in the production of cells first by the Burgess Laboratories and then by Burgess Battery Company. Some of

these discoveries and inventions were patented. Those which were patented in the name of Burgess were the two impalpable graphite patents,[177,122] the "tin bottom"[137] cell in which tin or terne plate was substituted for zinc in dry cell bottoms (during World War I) and which is described more at length in the section on Corrosion, and methods for chemically treating manganese ores, of which one covers the roasting and extraction of manganese dioxide ore[138] to make it more active, whereas the other covers the leaching of such ores[139] for the primary purpose of removing soluble metal impurities deleterious to the shelf life of the cell. The processes of these two patents were of particular importance during World War I when, because of the scarcity of manganese ores, it was necessary to make use of low-grade and impure ores. The two processes made it possible to improve these ores sufficiently to make acceptable cells. A patent[140] was issued to him also on the treatment by acid extraction of the depolarizing mix of exhausted dry cells to recondition it for re-use in dry cells as practiced by the two Burgess companies after the outbreak of the war in 1914 (Chapter 22).

Not only did Burgess establish the value of impalpable graphite in dry cells but twenty years later he pioneered the use in cells of another type of finely divided carbonaceous material, acetylene soot, known as Shawinigan Black (Chapter 26), an improvement of equal importance.

Burgess's interest in carbon was much broader than indicated by the improvements he effected in dry cells, first by the use of impalpable graphite and later by the use of acetylene soot. Before he became closely associated with the dry cell industry in 1907 the records show his deep interest in the properties and uses of carbon and graphite. After 1907 he necessarily increased that interest because of the important role of carbon in dry cells both as the positive electrode and the conductive element of the depolarizing mix. His goal at that time was to get into the carbon business. Although he and his Laboratories rendered engineering service to the carbon industry it was not until the '30's that he became directly connected with the manufacture of carbon products, at which time he put his knowledge of the industry to use in starting the Burgess Battery Company in the manufacture of its own carbon pencils.

The zinc cans used as dry-cell containers also received extensive study on the part of Burgess, particularly those used for miniature cells. When, in 1909, he had progressed far enough in his research work on the production of such cells to believe that he would soon have a salable product, he was dissatisfied with soldered cans. He also wanted the zinc to be of the highest purity and consequently experimented on the production of cans by electrodeposition. Though Burgess was considered to be an expert in zinc electrodeposition (see section on Metal Coating and Electro-refining) neither he nor any of the companies then either installing zinc electrodeposition processes or doing zinc electroplating could deposit non-porous zinc of the requisite thickness.

Burgess never lost sight of the 1909 pure-zinc-without-soldered-seams goal. By early 1917 he was convinced that instead of forming the can by electrodeposition it should be possible to draw a seamless can from the high-purity soft Horsehead brand sheet zinc rolled by the New Jersey Zinc Company. He put Lorenz Maisel, the Company's mechanic and designer, on this job and before the end of the year, Maisel, with the help of Burgess's enthusiasm and guidance, had solved the problem.[243] In 1918 Burgess Battery Company was making such cans for its own use (Chapter 22). It is still making them.

In the drawing of the zinc cans from zinc strip a large amount of zinc scrap was produced. Such scrap, though the zinc was of high purity, when produced in the Middle West did not command a premium price, and, therefore, substantial savings could be effected if Burgess Battery Company could use it to roll its own drawing-strip. However, metal-rolling experts advised Burgess not to attempt to roll zinc because of the technical difficulties involved. The scrap zinc was, therefore, for the time being, used to produce pure cast-zinc anodes for electroplaters, as told in the section on Metal Coating and Electrorefining, and also for the production of zinc chloride for use in cells by the direct reaction with chlorine, a process devised at the Laboratories.[245] Burgess, an expert in certain phases of zinc metallurgy, was still of the opinion that it would be possible to work out the equipment and method to roll zinc without too much difficulty and that this could be done by the Company's own engineering staff. After a delay of some years and after some preliminary experimental work, a zinc rolling mill was installed and, with his encouragement, the Burgess Battery Company engineering department with the benefit of some outside advice, soon was rolling strip zinc successfully. Thereafter the Company rolled all of its own zinc for its domestic needs and later installed a rolling mill in its Canadian plant.

Though Burgess was responsible personally for the development of the drawn can this did not deter him from devising other types of containers. Some years later he suggested a new method for making zinc cans from zinc foil rolled into a multilayered cylinder with a suitable adhesive between the zinc layers. The patents issued in 1941.[154,155]

Another product of the early research was the development of a "refrigerated" paste for producing the electrolyte separator layer in the small cells. This method was used commercially for many years in Burgess-made cells. The patent was issued in Hambuechen's name.[244]

Still another discovery was made at that time—that the corrosion of the zinc can while the cell was standing "on shelf" could be materially lessened by adding a small amount of a soluble chromate to the electrolyte to form a protective chromate film on the zinc. This method for inhibiting the corrosion of zinc dry cell cans has been used continuously by Burgess Battery Company. It was maintained at first as a trade secret. This trade secret was involved in the lengthy litigation instituted by the two Burgess Companies against the French Battery and Carbon Company et al in 1921 (Chapter 22). For the use of this secret process following the unauthorized disclosure to it by O. E.

Ruhoff the French Company paid damages of nearly $47,000 and also assigned to Burgess Battery Company a Ruhoff patent[246] on the use of chromate in dry cells.

When it was learned in 1912 (Chapter 21) that a chemically-prepared manganese dioxide apparently was needed to produce a dry cell of high capacity, the Laboratories started an intensive research program to produce a suitable dioxide. Burgess turned to electrochemistry for a solution of the problem and experimental work was done on electrolytic manganese dioxide. However, this work was discontinued when he made the impalpable graphite discovery which eliminated the necessity for the time being for using chemically-prepared dioxide. Later the chemically-prepared manganese dioxide project was revived and Burgess again stressed the electrochemical method. However, it was nearly thirty years after he first proposed the use of the electrolytic manganese dioxide that the method got beyond the laboratory stage and the product was used in cell production by Burgess Battery Company. During the second World War Burgess saw the electrolytic manganese dioxide really come into its own in LeClanche dry cells used by the armed services delivering a maximum of electrical energy from a minimum cell volume.

When an employee demonstrated to Burgess that a 1½-volt battery made by connecting four flashlight-type cells in parallel, though occupying about 1/3 less space than the 6-inch cell, delivered an equivalent amount of useful energy, he reacted quickly. As soon as he was convinced that this new type of battery had a decided advantage from the standpoint of performance on the basis of space occupied, he acted in his characteristic manner—in accordance with his convictions—regardless of the objections raised to the discontinuance of No. 6 manufacture (Chapter 27). His decision was justified in the course of time and much of the 6-inch cell business in this country has been replaced by the multiple-cell type battery pioneered by him.

Burgess not only was active in improving the quality of dry cells but he also was mechanically-minded and was active in designing new mechanical features and machinery used in the plant. He was particularly active in improving flashlight cases and lanterns. His activities in these fields are evidenced by the considerable number of patents issued to him.

Patents were granted to him on the following cell or battery inventions: a cartridge-type flashlight cell;[120] a 3-volt battery (6-inch type) construction;[123] a tubular flashlight battery construction which eliminates and is substituted for the barrel of the cylindrical case, a lamp-head being detachably secured to the battery,[128] that is, a caseless flashlight; a cell in which the zinc can has a crimped edge;[144] a multiple-cell battery with wire-mesh connector;[146] a special-type hexagon-shaped battery;[152,158] and a process for making wrappers for flat flashlight batteries together with the machine used to operate the method[125,126,127].

Burgess was very active in the designing of flashlight cases and lanterns and 18 patents were granted to him on this phase of the bat-

tery business. He made some important improvements. An important early patent granted to him in 1914[115] covered a non-short-circuiting case. Up to this time a flashlight case was short-circuited when the metal head and end-cap were electrically connected, for example, when the case was laid on a piece of metal as it was when put into a box of tools. After users of such cases complained to Burgess of this defect he promptly did something about it by the judicious use of insulation. It was not surprising, therefore, that this patent became involved in litigation because every case manufacturer immediately copied the improvement. The patent was upheld in the District Court in the suit filed against the Novo Manufacturing Company in 1918. Plans were then made to enforce the patent against all other infringers, who thereupon collectively financed an appeal of the Novo decision with the result that the Circuit Court of Appeals of the Second Circuit[309] held that the improvement was a simple and obvious expedient that did not rise to the dignity of invention. The patent was then reissued with innocuous claims. In 1919 three additional patents were issued to Burgess[134, 135, 136] covering different constructions for rendering cases non-short-circuiting.

In the early tubular flashlight cases the construction was such that the bulb was damaged or smashed if the case was dropped or if the bulb was screwed in too tightly, because the bulb base abutted the central positive terminal of the battery. Burgess also solved this difficulty by his invention of the "bumper-block" construction which was the subject of three patents[133,141,143,] issued between 1919 and 1922.

He devised a focusing construction which was the subject of a patent granted in 1922.[142]

One of his early goals was the elimination of flashlight cases by making the battery itself the case and attaching to it a removable head containing the bulb and switch. The constructions of such heads were covered in three patents issued to him in 1919[129,130,131,] the special battery construction having been referred to previously.[128] This construction was marketed for a time by Burgess Battery Company during World War I under the British-flavored trade mark "Tommy-Torch."

Two patents were issued in 1938 to Burgess on a fountain-pen type of case[150,151] the second of these being directed to the switch construction.

Three of his early patents[114,119,132] covered miscellaneous details of flashlight case construction and three others[118,157,149,] related to electric lanterns.

Burgess not only improved the quality of dry cells but he improved the marketing by eliminating the use of the messy and flammable hay, straw and excelsior which was universally used to pack No. 6 cells in boxes and barrels for shipment. He substituted layers of felted fiber such as "Flaxlinum" as described in the patent granted to him in 1918.[124]

Section III

ELECTROLYTIC IRON AND IRON ALLOYS

THOUGH Burgess was interested as an electrochemist in the electrodeposition of all metals, the electrodeposition of iron appealed to him both as an electrochemist and as an electrical engineer; as an electrochemist because of the potential commercial possibilities involving the production of large tonnages, and, as an electrical engineer because electrolytic iron promised to be useful in improving the performance of electromagnetic machinery. His early interest is shown by his rash prediction that iron would some day be refined electrochemically, made in a talk (not published) on "Electrochemical Processes" late in 1898 before a local meeting in Chicago of the American Institute of Electrical Engineers.

Burgess began investigating the magnetic properties of electrolytic iron prior to 1900. In an article on the Electrochemistry Department appearing in the *Wisconsin Engineer,* for May 1899,[1] the "Magnetic Properties of Electrodeposited Iron and Nickel" is one of the 15 subjects listed as being investigated in the Department at that time. No doubt he electrodeposited the iron that was used for these experiments by methods that were well-known at that time, methods which were entirely unsuited for commercial purposes. There is no record of any systematic study of the electrodeposition of iron by him until after he entered into the contract with the Johnsons on December 31, 1900 (Chapter 11). That contract appeared to be at least one incentive that caused him to begin an intensive research program.

Though Burgess and Hambuechen state in their paper (April 1904) on "Electrolytic Iron"[2] (Chapter 13) that the experimental investigation had been started more than two years previously, the first published record linking Burgess directly with electrolytic iron experimental work is found on page 338 of the Patten and Mott[201] paper on "Single Potentials of Zinc in Aqueous Solutions," the work having been done under him (p.344). In a reference to the plating of iron out of iron solutions, the authors state, "In 1902, one of us, together with A. B. Marvin succeeded in getting a smooth coat of iron which stood buffing remarkably well." The next sentence then tells of the importance of keeping the iron in ferrous condition, which was done by adding methyl alcohol to the plating solution.

Marvin in the early part of 1902 was an instructor in the Applied Electrochemistry course and also was working for the Johnsons under

Burgess's direction. Burgess, therefore, knew of this "smooth coat of iron" and the conditions necessary for its production. In later years he stated that it was at about this time that Hambuechen showed him a small piece of electrodeposited iron of considerable thickness "about the size of a half dollar", as related in Chapter 13. However, the final bath used by Burgess and Hambuechen did not contain methyl alcohol.

Burgess and Hambuechen[2] relate (at page 202) that a long period of investigation covering two years and involving hundreds of tests was required before it became possible to produce, with an electrolyte of ferrous and ammonium sulfates, the massive deposits of iron three-fourths of an inch thick which industry required. With a potential drop of one volt 2.2 pounds of iron were produced per kilowatt hour at a current efficiency of deposition of nearly 100 percent. They further describe some of the properties of the iron so produced, its possible uses, and sum up the work by stating "that it is possible to obtain electrolytic iron in large quantities and at a reasonable cost, and that, therefore, iron should be added to the list of metals to which the process of electrolytic refining can be applied satisfactorily." There is nothing in the records to indicate that a patent application was filed or that the filing of a patent application was contemplated.

In his September 1903 report to the Johnsons, Burgess stated that four pounds of electrolytic iron were being produced daily at the University. However, as a result of the termination of the contract by the Johnsons (Chapter 11) the lack of finances made it necessary to curtail the electrolytic iron work. A considerable amount of this iron was consumed in experimental work at the University and much of the rest of it was sent to persons outside of the University including Prof. Henry M. Howe of Columbia University, Robert Hadfield of England and Dr. John A. Mathews, metallurgist for the Crucible Steel Company of Syracuse, New York. Mathews wanted some of the heavier plates for rolling experiments but Burgess found it difficult to produce plates of sufficient thickness that had the required smoothness for the purpose. Mathews, who was greatly interested, wrote Burgess on September 24, 1903, to "get me a good thick cathode for the St. Louis Exposition—it will attract much attention."

The paper presented before the American Electrochemical Society in April 1904 brought Burgess much publicity. It was headlined in the front page news of a Pittsburgh newspaper the following day. Hundreds of letters were received by Burgess during the next few years from all over the world asking for samples and for detailed information about the production of electrolytic iron. Other writers wanted the job of selling the new iron for him, others offered to erect plants at his expense for its production, some wished to sell him iron-ore properties or sell his patents for him, while others obviously were financial schemers who apparently thought all college professors were "suckers". In September 1905 Burgess estimated that he had received requests for over a ton of samples.

In his 10-page typewritten petition dated July 25, 1904 to the Car-

negie Institution of Washington asking for $3,000 per year for two years to carry on further research on electrolytic iron and its alloys (Chapter 13), Burgess set forth what had been accomplished on the subject at the University of Wisconsin and an outline of the proposed work which was to be done together with its probable value to the scientific and industrial world. Among the matters to be investigated on a systematic basis were the following:

> A determination of the properties of chemically pure iron, and the influence of heat and mechanical treatments as affecting these properties.
>
> A determination of the influence of various proportions of each of the important elements alloyed with iron upon the physical properties, and as influenced by various heat and mechanical treatments.
>
> A determination of the influence of various combinations of the several important alloying elements upon iron, and as influenced by the various heat and mechanical treatments.

The properties which were listed to be investigated included strength, elasticity, hardness, specific gravity, melting point, specific heat, heat conductivity, electrical conductivity and magnetic quality. Corrodibility was added later to the program.

The petition points out that in the preparatory work it would be necessary to include a study of methods and then design the apparatus for melting the material. This preliminary work took most of the first year.

Burgess summarized the work done under the grant in his yearly reports to the Institution and these are abstracted in the *Year Books*[22]. However, as the investigation progressed, Burgess and his co-workers published the detailed technical data which were obtained[3-22, 61, 202-210, 234, 253]. The contribution to science as disclosed in these 32 articles published over a period of seven years is outstanding and more than justified the grant made late in 1904 (Chapter 13).

Dr. Oliver P. Watts was employed to carry on the investigation during the first year. During the second year O. L. Kowalke succeeded Watts and subsequently James Aston succeeded Kowalke. These men were assisted by a considerable number of instructors and graduate students over the period of years.

The first annual report dated September 25, 1905, describes in detail the construction and operation of the electrolytic-iron cells together with the improvements effected during the year; analyses of the product are given; its properties after being formed into rods, sheet and wire are described; and the equipment devised for melting the iron is described. To obtain crucibles capable of withstanding the high temperatures required and to prevent carbon contamination of the iron, it was necessary finally to make special crucibles of magnesia which had been shrunk in the electric furnace. These crucibles with their iron charges were then heated in electric furnaces. Numerous photographs and microphotographs accompany the report. The iron was deposited in slabs up to

one inch in thickness at the rate of five pounds per day. Of particular interest is the statement in the report that the first alloys to be made would be those of iron and copper.

The second report, dated September 26, 1906, states that during the second year 1500 pounds of electrolytic iron were produced together with 221 alloys. The purity of the electrolytic iron is discussed at length because it contained a larger percentage of impurities than Burgess had anticipated in his earlier enthusiasm. Further improvement was made in the magnesia crucibles and in operating the furnace for melting the iron charges as described by Watts.[202] The work of determining the properties of the iron alloys had been started. The report lists the following additional published papers based at least in part on the investigations: "Structure of Electrodeposits;[3] "Iron and Calcium,"[203] in which are described unsuccessful attempts to alloy calcium with iron; "Limitations of the Ballistic Methods for Magnetic Induction;"[204] "Magnetic Properties of Electrolytic Iron;"[4] and "The Corrosion of Iron by Acids."[5]

The third report dated September 28, 1907 was short "since our results are not in such shape that a detailed report is warranted." Double-refined iron was made to increase the purity of the product used in the investigation. There is a touch of commercialism in the report when Burgess states:

> Judging from the numerous inquiries which have come to me it appears that electrolytic iron has commercial possibilities, although I do not know that it is in any way a commercial product yet. The principal prospective commercial use appears to be in using it as a substitute for the highgrade Swedish iron used for the manufacture of iron alloys, tool steels and the like. In our investigation, no extensive study has been given to the cheap production of the material, and a line of work which it is proposed to take up is to determine how good a grade of iron can be produced from the cheapest form of the impure iron and steel on the market. Thus far high-grade iron has been used as the anodes for the refining tanks.

294 satisfactory ingots were produced out of 313 crucible charges melted during the year and 262 satisfactory forged bars were produced from these ingots. The report refers particularly to a series of alloys with chromium, nickel, tungsten, vanadium, molybdenum and silicon, and points out that a "number of interesting observations have been made in the testing of these alloys, but reports will not be made until the chemical analyses can be secured." These alloys were some of the most important of any that were made. During that year Watts published the following article which was based on the investigation: "The Action of Carbon on Magnesia at High Temperatures."[205] It points out that magnesia is reduced by carbon to magnesium at high temperatures but that the reaction is reversed at lower temperatures. In addition, a thesis investigation was made by Bechlen and Wadsworth[253] of high-speed tool steels made from electrolytic iron. Burgess had early been of the opinion that electrolytic iron would prove to be a

superior raw material for the high-speed tool steels that were then a comparatively new development.

Burgess's report of August 31, 1908 states that the work lagged during the previous year because it was impossible to obtain competent assistants. However, the electrolytic tanks were kept operating so that over 1,000 pounds of iron were produced, a considerable part of which was shipped out as samples. Some alloys were made, particular reference being made to the production of alloys of iron and calcium under pressure.[206] Reference is also made to the paper by Burgess on the influence of strain and the crystalline structure upon the corrodibility of iron,[6] this paper being referred to more at length in the Corrosion section.

In the report dated September 23, 1909 it is stated that the work during the previous year was largely directed "to the study of the magnetic and other physical properties of the materials." The report is of particular interest because it points out the superior magnetic qualities of some of the alloys, both for use as permanent magnets and for use in transformers. Some of the alloys are indicated as having superior resistance to corrosion by acids. In addition to the thesis submitted by James Aston for his Chemical Engineering degree entitled "The Magnetic Properties of Electrolytic Iron and Iron Alloys"[234] the following papers were published and listed in the report: "Observations on Alloys of Electrolytic Iron with Arsenic and Bismuth,"[7] in which are described some of the physical and magnetic characteristics of these alloys together with some alloys with antimony; "Influence of Arsenic and Tin upon the Magnetic Properties of Iron;"[8] and "Effect of Temperature on the Magnetic Properties of Electrolytic Iron."[207] Burgess states in his annual report that the work showed that "The presence of arsenic or of tin in iron improves the magnetic qualities of the material for use in electrical transformers and the like."

The final report was dated September 20, 1910. The electrolytic iron tanks were continued in operation and the work on alloys was confined largely to an investigation of the combined influence of copper and nickel on the strength of iron, the making of hardness tests on numerous alloy samples, and the determining of the utility of electrolytic iron as a base material for the manufacture of tool steels. The report calls particular attention to the important fact that one and one-half percent of copper gives an increase of strength equal to that produced by four percent of nickel and that it was found "that the presence of copper is not detrimental in making iron-nickel alloys and, therefore, Monel metal, a cheap source of nickel, may be used for making high-grade alloys." The following papers are listed as having been published during the previous year though some data and information remained to be prepared for publication: "Some Physical Characteristics of Iron Alloys",[9] in which are described the forging, welding and machining characteristics of a large number of alloys made with 17 different metals and combinations of metals, some of which produced alloys with self-hardening properties; "Observations Upon the Alloys of Iron and Managanese"[10] (this relates largely to the magnetic properties);

"Physical Properties of Iron-Copper Alloys",[11] in which the data show that 1½ percent of copper is equal to 4 percent of nickel for increasing the strength of iron as stated above; "Magnetic and Electrical Properties of Iron-Nickel Alloys";[12] "Magnetic and Electrical Properties of Iron-Copper Alloys";[13] "Magnetic and Electrical Properties of Iron-Silicon Alloys";[14] "Strength of the Alloys of Nickel and Copper with Electrolytic Iron",[15] in which the value of these metals for producing high-strength alloys is demonstrated; "Magnetic Properties of Electrolytic Iron and Some Commercial Steels";[16] "Strength of the Alloys of Electrolytic Iron and Monel Metal",[17] in which it is shown that the cheaper Monel metal may be substituted for the more expensive nickel for making iron-nickel alloys as stated above; "Corrosion of Iron Alloys";[208] "The Specific Heat of Nickel-Iron Alloys as a Function of Their Composition";[209] and "Hardness Tests on Alloys of Nickel and Copper with Electrolytic Iron".[210]

The following important papers based on the work done under the grant were published after the final report was rendered in September 1910: "Some Alloys for Permanent Magnets";[18] "Influence of Various Elements on the Corrodibility of Iron";[19] and "The Electrical Resistance of Iron Alloys".[20] The two papers on permanent magnets and electrical resistance were of far-reaching significance. A number of these alloys proved later to be of commerical importance. The importance of the corrosion paper is shown in the section on Corrosion. The work on the production of electrolytic iron was summed up finally in 1911 in a short paper entitled: "Electrolytic Refining as a Step in the Production of Steel".[21]

The significance of the work done by Burgess under the Carnegie grant is indicated by the above recitation of the papers that he and his co-workers wrote. After the funds of the grant were exhausted no more funds were voted by the Institution for further research work of this type and there was little or no money available from University appropriations. Burgess was strong in his conviction that electrolytic iron had a place in industrial iron metallurgy and so expressed himself in a talk entitled "Electrolytic Iron—Can it be Made an Industrial Product?" given before the Chicago Section of the American Electrochemical Society on January 20, 1911.[61] He, therefore, planned for the continuation of the work by his own Laboratories and was about to reactivate the project in 1912 under the active direction of James Aston when the latter resigned from the University of Wisconsin and the Laboratories. This caused Burgess to postpone further work in this field. The work so postponed was never again revived to the point where research work on electrolytic iron alloys was resumed though he was still planning to do so immediately before his death.

Section IV

METAL COATING AND ELECTRO-REFINING

DURING the earlier years of Burgess's career the science of electroplating and the electro-refining of metals received much attention from him. This section, however, does not include his work on the electrolytic refining of iron which is described in the previous section. The first technical paper published by Burgess (Chapter 5) in a technical magazine (1898) was on the subject of electroplating on wood[36] and other non-conductive materials.

Zinc Electrodeposition

Burgess did research work on the plating of many of the metals but he was particularly interested in zinc. Although it was known how to electroplate zinc at the time he was an instructor at the University it was not possible to deposit dense and adherent coatings of sufficient thickness to make them of much value for the protection of iron and steel. These porous deposits were a challenge to him, particularly because whoever solved the problem would likely be rewarded in a material way. As late as 1903 he summed up the status of the zinc plating art in a letter dated June 2 to Abraham Van Winkle by stating "it seems that zinc plating is at about the same stage of development now that copper deposition was twenty-five or more years ago." A few weeks previously in a letter dated May 16 he had complained: "It is a somewhat peculiar fact that while electroplating is the oldest practical branch of electrical engineering, its literature is the most unsatisfactory and out of date of any of the branches."

Burgess's notes indicate that he was working on the problem as early as 1897 as indicated by the following statement in a paper (apparently not published) on zinc electrodeposition: "On June 14th, '97, I began a series of experiments with zinc to determine if possible some relation between the character of deposit and the dissociation of the liquid, also to explain some of the phenomena by means of the dissociation theory." This research program continued over a number of years on both the acid and cyanide baths. It included a study in his department by H. E. Patten and W. R. Mott[201] of the single potentials of zinc in aqueous solutions. He was assisted by Carl Hambuechen after 1900 under the Johnson arrangement (Chapter 11). The results of this latter work are incorporated in a lengthy paper on "Electrogalvanizing"[30] by Hambuechen and himself in 1902 and in his

later articles in 1905.[31, 32] These articles are also referred to in the section on Corrosion.

Burgess was an enthusiastic advocate of electrodeposited zinc coatings in preference to hot-galvanized coatings because of their purity, as pointed out in the above articles. In a letter dated April 21, 1905, to the Pratt Chuck Company, Frankford, New York, electroplaters of pipe fittings, Burgess states: "The conclusions which I have drawn from an extensive investigation of the relative protective power of zinc deposited electrolytically and by the old hot process show that a 12-gram electrolytic zinc coating has a protective action about equal to that of a 28-gram zinc coating applied by the ordinary hot galvanizing process."

On April 17, 1902 Burgess wrote to his patent attorneys asking for a preliminary examination as to the patentability of an alloy of zinc and mercury for the anode in zinc plating. The amalgamation overcame the uneven corrosion and other difficulties encountered with ordinary zinc anodes. His attorneys replied that the invention appeared broadly patentable based on a search of United States, British, German and Swiss patents. Burgess replied that he was investigating further but there is no record of the filing of a patent application. Amalgamated zinc anodes apparently were referred to when he made his report to the Johnsons in September 1903 (Chapter 11) when he stated "We found a means for producing a smooth corrosion of zinc from the anode and this idea will probably have some commercial value." Amalgamated zinc anodes in later years became and still are of commercial importance. They were made the subjects of patents by others many years later after being mentioned incidentally in the Abraham Van Winkle U. S. patent No. 901,758, issued October 20, 1908 on an application filed on October 24, 1907.

Burgess, however, trailed others in devising a satisfactory zinc plating bath for he also reported in September 1903 to the Johnsons "There was placed on the market a process similar to ours and giving more satisfactory results and the work was therefore abandoned." This was the end result of several years of active work on electrogalvanizing including some consulting work. For a number of years after 1903 he carried on further research on the zinc plating problem but the efforts were no longer as sustained and no further articles were published after 1905. Nothing of commercial importance resulted directly from his efforts. During these years he worked closely with the Hanson & Van Winkle Company. The voluminous correspondence shows that he assisted that company in their development of a satisfactory plating bath.* He continued to favor electrogalvanizing over hot galvanizing.

After 1910 Burgess's interest in electrogalvanizing soon gave way to other activities. However, in 1922, when Burgess Battery Company

*Ernest H. Lyons, Jr. states in *Modern Electroplating* (The Electrochemical Society, 1942) p. 345, that: "It was in about 1910 that the introduction of improved electrolytes, better control and more efficient cleaning methods resulted in more successful electrogalvanizing."

was beginning to produce large amounts of zinc scrap of high purity from the Horsehead brand zinc used in the drawing of seamless zinc dry cell cans (see Batteries section), Burgess's interest in zinc plating was revived when he learned that the high grade zinc scrap could not be sold on the scrap market at premium prices. He concluded that it should make superior zinc anodes and thereby obtain a return for the scrap in keeping with its purity. An investigation[306] confirmed his conclusions which were based on his experimental work of twenty years previously. Further investigation showed that most zinc anodes then (1922) on the market were made of relatively impure zinc. The scrap was thereafter cast into anodes which found a ready acceptance in the electroplating trade and this business continued until Burgess Battery Company started rolling its own strip zinc used in the production of zinc cans. These pure zinc anodes set a new standard in the zinc-plating industry.

Nickel, Copper, Lead Electrodeposition

Although Burgess did considerable investigative work on the plating of nickel in his earlier years at the University, it was his assistant, Dr. O. P. Watts, who effected important improvements in that art. Burgess paid particular attention to the anode.[94] With Hambuechen[38] he determined the distribution of the current at the anode surface in a nickel-plating bath and showed that an anode of oval or elliptic cross-section corroded to a thin strip with a minimum residue of unused metal. This type of nickel anode was first marketed by the Hanson & Van Winkle Company in 1903 and was the subject of considerable correspondence with Burgess at the time. He also had an investigation made in 1903[220] of the effect on nickel-plating of various qualities of anodes.

Burgess became interested in improving the methods for the electro-refining of copper. This work culminated in a paper before the American Electrochemical Society in 1905[39] entitled "Notes on Economic Temperatures of Copper Refining Solutions." Also several years previously, in his departmental report of December 31, 1901, to Dean Johnson of the College of Engineering, he referred to work being done on the manufacture of copper tubes by electrolytic means. He described this method to his patent attorney as follows: A coating of lead was first plated on an iron mandrel and the copper was plated to a suitable thickness onto the lead. After this "the resultant tubing can then be spun or drawn to the desired thickness, after which the mandrel is removed by heating beyond the melting temperature of lead, when the copper tube becomes loose." The attorney advised him, however, that he was not the first to use this principle.

Burgess, in his letters and reports during the period from 1901 to 1905, several times referred to the excellent electroplated coatings of lead that he was producing. However, he did not publish anything on this and it must have been a matter of minor interest to him.

Electrodeposition on Aluminum

At the request of a Milwaukee manufacturer in about 1901 Burgess devised a method for depositing an adherent plate of gold on dance-slipper aluminum heels (Chapter 20). Up to that time no method was known for depositing an adherent plate of any metal on aluminum. Although he could not form an adherent plate of gold directly on the aluminum, he, working with Hambuechen, found that by preparing its surface properly an adherent coat of zinc could be deposited from a bath to which a small amount of hydrofluoric acid or a soluble fluoride had been added.[37] Zinc provided the most adherent plate of any metal. Other metals were then deposited on the zinc though the gold required a second intermediate metal such as copper because it diffused slowly into the zinc at room temperatures. He included a reference to his success in plating copper on aluminum in his first departmental report to Dean Johnson on December 31, 1901.

Miscellaneous

Burgess studied the equipment used in electroplating plants at an early date. He discussed this subject in a paper in 1898.[40] He was much interested in the adherence of electrodeposits from both its practical and theoretical aspects. These are both discussed in two joint papers with Hambuechen in 1903.[41, 42] Considerable research work also was done under his direction at that time in the applied electrochemistry laboratories on the use in electrodeposition of rotating electrodes and a circulating electrolyte as reported by Zimmerman.[221]

Burgess made an important contribution to the art of preparing metal surfaces for the electroplating operation. This subject received much attention by him and at an early date. In the summer of 1897 while carrying on experimental work in the University laboratories he wrote to Prof. D. C. Jackson on July 19:

> I have just been experimenting on the removal of asphaltum, lacquer, enamel, etc., from metallic surfaces electrolytically and have obtained some quite interesting results. It can be done by employing the article as a cathode, using a rather high current density, and it appears to me that it might be employed in preparing metal for re-enameling and plating. I sacrificed part of my bicycle frame and found that the enamel could be removed much more readily and smoothly than by means of the monkey-wrench or by running into the curbing. I commenced to write about it to the *Western Electrician* but thought I would first ask your opinion as to whether it would be of any practical value or whether it was already well known.

The letter does not specify the electrolyte that was used but his later correspondence indicates that he probably used common salt. Considerable experimental work had been done during the previous school year in the electrochemical laboratories on the electrolysis of common salt and it is probable that he had observed the nature of the cathodic action on the iron cathodes used. Shortly after writing the July 19th letter he learned that the cathodic cleaning action was of practical value as may

be inferred from his letter of April 11, 1898 to Prof. K. G. Brownell of the Louisville Manual Training School, Louisville, Kentucky, in which he said:

> While carrying on the laboratory work in plating during the past semester, our lye tank 'sprang a leak', rendering it useless, and in order to keep the work going I tried a plan which I have had in mind for some time, of cleaning the metal without the use of hot lye or potash. It consists of this: the work to be cleaned is hung as a cathode in a solution of common salt (NaCl), the anode being of carbon, which is not appreciably attacked by the electrolysis. On passing a current of a rather high density, say 30 or 40 amperes per sq. ft. of cathode surface, for a few minutes, the metal is removed from the solution, rinsed, and placed in the plating tanks. The plating then done was very adhesive, and entirely satisfactory. The advantages of this process are the use of a cold solution, shorter time for cleaning, and no need of brushing the work with whiting, as is ordinarily done, thus avoiding contact with the hands from the time the work is placed in the cleaning tank until it is removed from the plating tank. Surfaces which have been buffed can thus be cleaned without in any way interfering with the polish it received. This process has proved so satisfactory for our laboratory work that I have decided not to have the lye tanks repaired. Of course in working this process on a large scale, the evolution of chlorine from the NaCl solution might become so copious as to be offensive and dangerous to the workmen, and consequently a ventilating hood would have to be used, or another solution used in which the liberated gases would be inoffensive.
>
> By this method, not only will a film of oxide be removed, and a layer of oil or grease removed, but metals coated with enamel, lacquer, paint, etc. will have the coating removed very readily, and, in fact, after trying in many ways to insulate a metal plate by such a coating, I found that whenever gas was liberated copiously at the surface, the coating would invariably peel off.
>
> From the extreme simplicity of this process of preparing metal surfaces for plating, lacquering, etc., and the apparent advantages it seems to me strange that it is not in use. I have endeavored to find some printed reference to it, but after going through all plating works available, I can find no mention of such a process.

Burgess attempted to make some commercial installations early in 1898 based on the use of the salt solution but the chlorine evolution proved too objectionable. Later in 1898 he found that he could secure equally satisfactory results by substituting "common lye" for the salt and thus eliminate the chlorine nuisance.

In the latter part of 1898 he published an article on the process[13] and also gave a talk on it in Chicago before a local meeting of the American Institute of Electrical Engineers (Chapter 6). He applied for a patent but found that Thomas Edison, who was ahead of his time, had patented it about 20 years previously (Chapter 6). Because of the publicity given to it the process soon was generally adopted for the cleaning of metals in preparation for the electroplating operation, and Burgess, therefore, has been given credit for its commercial introduction.

Burgess was also interested in another phase of metal preparation

for coating operations—the pickling of iron and steel. He gave this subject considerable study because of its importance in the electrodeposition of metals. He wrote a number of papers[27, 24, 5] on this subject which is discussed more at length in the section on Corrosion.

On December 14, 1912, Burgess gave a paper before the Chicago branch of the National Electro Platers Association on "The Application of Chemistry to Electroplating",[44] following which both he and Dr. O. P. Watts were made honorary members of the Chicago branch (Chapter 20).

In 1913 one of the clients of his Laboratories asked Burgess to solve the problem of "spotting-out" on silver-plated automobile headlight reflectors which had arisen in the client's electroplating department. The solution of this problem required much patience and painstaking care combined with tact because it involved plant personnel. Progress in the solution of the problem is described in a paper presented to the American Institute of Metals in 1913.[45]

Sherardizing

At the time that Burgess was testing the sherardized coating for the U. S. Sherardizing Co. in 1909-10, as described in the Corrosion section, he did independent research work on it. He found that iron could be sherardized by substituting the relatively cheap waste product—galvanizer's dross—for the high-priced "blue dust" then used. However, the dross was not a practical material because of operational difficulties that were encountered. He solved the problem by adding several percent more of iron to the several percent that the dross contained, thereby producing a granular, crystalline and high-melting-point zinc-iron alloy containing from 7 to 10 percent of iron, which did an excellent job of sherardizing though slightly higher temperatures had to be used. He patented this new development and the patents[107, 108, 109, 110] were subsequently purchased by the U. S. Sherardizing Company (Chapter 21). This alloy was used commercially in a number of sherardizing plants.

Section V

CORROSION AND ITS PREVENTION

Corrosion by Electrolysis

THE specialized problem of corrosion by electrolysis, sometimes called "stray-current electrolysis", came to the attention of Burgess early at the University. Prof D. C. Jackson was recognized as an expert in this field at the time that Burgess was an undergraduate in Jackson's electrical engineering course. Considerable investigative work on the subject was being done in the department during Burgess's early association with it and Jackson wrote a number of papers on the subject. Although Burgess's name is not associated directly in any of the earlier records with the electrolysis problem, it nevertheless is not surprising that he was requested in 1902 by the Beloit Water, Gas & Electric Company of Beloit, Wisconsin (Chapter 14), to survey the electrolysis situation there.

It was not until 1907 that electrolysis corrosion problems began to be of importance to him. In that year Jackson left the University and Burgess was appointed to a newly-created job on the Wisconsin Railroad Commission (Chapter 14). He thereby came in close contact with the operating and engineering departments of the gas and electric utilities in the state and obtained first-hand knowledge of their electrolysis problems. Insofar as Wisconsin utilities were concerned he made electrolysis surveys in a number of cities in the state as part of his duties with the Commission who deemed the subject to be of much importance (see section on Utility Regulation). He studied the electrolysis problem with his usual vigor and enthusiasm.

He was in contact with experts and with utility-regulation bodies in other states where this problem had likewise arisen. Within a few years he had made electrolysis surveys in the Wisconsin cities of Milwaukee, Madison, Oshkosh, Fond du Lac, Janesville, Green Bay and Beloit.* His ability was soon recognized outside of the state and he studied and reported* on electrolysis problems that arose in Waukegan (Illinois), Wilkinsburg (Pittsburgh, Pennsylvania suburb), Austin (Texas) and Chicago. In Chicago, this problem came to a head in 1908 and a committee was formed to study the problem, each public utility having a representative on it, Burgess representing The Peoples Gas Light & Coke Company. The committee did not finish its study until 1911.[96] The findings were not published. Many years later he summarized the work of this Committee by making the following notation on the Chicago report

*C. F. Burgess Laboratories' technical report files.

referred to above.[96] "The work done by this committee produced no specific tangible results as far as elimination of electrolysis of underground structures is concerned . . . the pressure brought by the Gas Company against the electric railway companies for damages never resulted in actual litigation."

Burgess was again asked to survey Chicago electrolysis problems when he renewed his consulting arrangement with the Peoples Company in 1919, and he continued in this capacity until 1932.

One of the serious problems that was the subject of much discussion was that of the effect of electrolysis on iron and steel encased in concrete, particularly the reinforcing in concrete foundations of buildings and other structures in cities. Burgess investigated this subject at the University. He reported the results in a paper before the Western Society of Engineers in Chicago in 1911[35], for which paper Burgess was later awarded the Octave Chanute medal by that Society. The important and far-reaching conclusion reached by him in that paper, namely, that the concrete itself appeared not to be disintegrated by the electrolytic action nor destroyed by the corrosion of the metal, was contrary to the conclusion of earlier experimenters that the concrete disintegrated under these conditions.

Burgess lost much of his interest in electrolysis problems when he found that scientific ability and technical judgment often had to be subordinated to political maneuvering and pressures. This was distasteful to him. He declined to take on further jobs with new companies when his reputation was at its peak. In a letter dated November 16, 1911 to Prof. A. F. Ganz of Stevens Institute of Technology, an outstanding authority on electrolysis, he said: "I am finding the electrolysis work very interesting, but on account of certain characteristics of the work I am not trying to get into this field any further than I am now in it." A further factor which probably also influenced him was his desire to pay more attention to manufacturing ventures than to consulting jobs. As a result of his decision he declined a number of new out-of-Wisconsin electrolysis jobs that were offered to him. Nevertheless in 1918 he served on the Electrolysis Committee of the American Gas Association which rendered its report in 1919.[46]

Iron and Steel Corrosion and Its Prevention

During the time that Burgess was on the faculty of the University of Wisconsin he devoted much time to the corrosion problem; he was a recognized expert in that field, including the specialized field of corrosion by electrolysis. After resigning from the University in 1913 he devoted less and less time to this problem, the manufacture of dry cells demanding more and more of his time. He, however, never lost interest in it.

At the turn of the century the corrosion problem was receiving greatly increased attention on the part of scientists. There had been an increasing volume of complaints from users of iron and steel to the effect that it was corroding much more rapidly than that made in the "good old

days." The rapid growth of electric street railways at that time was attended by a rapid increase in the amount of destructive corrosion caused by "stray-current electrolysis." All industry likewise was growing rapidly and this increased the number of corrosion problems. The several theories of corrosion and particularly the new electrolytic theory were receiving increased scientific attention whereas manufacturers were becoming increasingly interested in the practical aspects of corrosion prevention such as the increased corrosion resistance of metals and improved protective coatings.

Though several theories of corrosion were being debated at the time the electrochemical theory proposed by Whitney was gradually being accepted by more and more scientists. Walker[215] fixed 1907 as the date when the electrolytic theory in its developed form was "offered as a basis for the explanation of the corrosion of iron and steel." The chaotic state of the art however was exemplified in Burgess's opening statement in his talk to the Engineering Society of Wisconsin in 1910 on "Some Experimental Observations on Iron Corrosion"[26] when he observed that:

> It is worthy of note that much has been written and that little is known about rusting and corrosion of iron. The literature on the subject abounds in contradictory statements, useless discussion and controversy, much of which is based upon inaccurate observations and data wrongly interpreted.

Burgess, because the electroplating of metals was of such importance to him in the early years of the applied electrochemistry course at the University of Wisconsin, became interested in the electroplating of zinc on iron and in the protection against corrosion afforded by such coatings Electroplating was of particular interest to him because it was an unsatisfactory art at the time and offered plenty of opportunity for research and improvement. It was not possible then to plate satisfactory zinc coatings of sufficient thickness to have any value as a protection to iron. Nevertheless, he was enthusiastic about their value as a protective coating as compared to hot galvanizing provided they could be plated to a sufficient thickness. His work on the electroplating of zinc to produce satisfactory coatings is described in the section on Metal Coating.

Burgess's early enthusiasm for electrogalvanized coatings for iron was based principally on acid corrosion tests that he made, sulfuric acid being used. He found that the electroplated zinc, because of its purity, dissolved at a much slower rate than hot galvanized coatings and from this he argued it was reasonable to assume that such coatings would resist better the corrosive atmospheres to which they might be exposed. These views are set forth in his articles on zinc coatings entitled "Electrogalvanizing,"[30] "Superiority of Galvanization by Electricity over that by other Processes,"[31] and "Investigation of the Properties of Zinc Coatings."[32]

He applied the same reasoning in explaining the superiority over modern galvanized sheets of the older material used by the French in 1887 when they were building a canal across the Isthmus of Panama. The

modern American material put into use nearly 20 years later failed quickly whereas the old French material was still doing duty. Burgess wrote to his former student, Edward Schildauer '97, an engineer for the Isthmian Canal Commission, who had sent him samples of the old product, pointing out that the French product was coated with a much heavier and purer layer of zinc, and:

> I believe that the French material must have been dipped without passing it through iron rolls which is the common practice today. I believe that the sheet galvanizing machines which are now employed stir up the zinc and the zinc-iron alloy in such a way as to make a non-homogeneous coating and one which has little resistance to corrosion. If the coating is imparted by dipping iron into a quiet bath of molten zinc the coating is liable to be thicker and with less mixture of the zinc-iron alloy.

Though Burgess did not publish any papers dealing with the iron corrosion problem until in 1905 he, nevertheless, began studying it early in his career at the time that he was studying the protective value of zinc coatings. He was interested at an early date in the electrochemical phenomenon of the higher potential in a corroding medium of strained iron when compared to the unstrained. One of his early students, Carl Hambuechen '99, investigated this phenomenon for his undergraduate thesis which was subsequently published with a foreword by Burgess as a University Bulletin.[211] Hambuechen's work was subsequently criticized by later investigators. Burgess thereupon had the work checked and he reported the results as a part of his Presidential Address to the American Electrochemical Society in 1908.[6] In this paper he conclusively shows that "strained metal *does* have a greater solution tension than the unstrained" as is spectacularly shown in the photographs accompanying the paper.

A second part of Burgess's Presidential address is devoted to the results of research done by himself and S. G. Engle on "The Influence of Inequalities of Temperatures Upon the Corrosion of Iron."[212] This was based on an investigation for the Chicago, Milwaukee and St. Paul Railroad of certain peculiar corrosion phenomena (pitting particularly) in its locomotive boilers. It was shown that there is set up in boilers the equivalent of galvanic cells because of the temperature variations, and, further, it confirmed the results obtained by W. H. Walker that "the presence of oxygen in a solution promotes corrosion by acting as a depolarizer and in this way allows a more ready passage of galvanic or corroding currents." The results went further, however, and established that in boilers "water which has been thoroughly saturated with air and consequently with oxygen, is especially corrosive when used as feed water." Burgess concluded that the galvanic action set up in a boiler is sufficient to be the basis for the belief that it could cause the pitting, in some cases the action being sufficiently rapid to cause perforation in a few days. Not only was he interested in the causes of boiler corrosion but he also was interested in preventing it. He turned to electrical means and advocated protection by means of counter currents provided by an outside power supply or by zinc electrodes coupled to the affected structure.

The above investigation of the boiler corrosion problem received much publicity and Burgess was called upon to address several groups on this subject, including the Western Society of Engineers in Chicago.[23]

Burgess showed much interest in the action of acids on iron and steel, particularly from the standpoint of the pickling of the iron and steel as a step in the surface preparation for electroplating and other coating operations. In 1905 and 1906 he wrote two papers entitled "Action of Acids on Iron and the Use of the Acid Pickle"[27] and "The Injurious Effect of Acid Pickles on Steel."[28] He also collaborated with Engle to present a joint paper to the American Electrochemical Society on the corrosion of iron by acids.[5] It presented data comparing the rate of solution in acids of several different types of iron and steel. Electrolytic iron as deposited was shown to dissolve more rapidly than zinc, whereas when heated to 1000°C. it became the most resistant of all samples tested. An important conclusion was that "The percentage of purity is not the controlling factor" in acid corrosion. This paper also presented additional data on the high degree of inhibition produced by the presence of small quantities of arsenic in sulfuric acid, this having been the subject of an earlier paper by Burgess entitled "Some Observations on the Influence of Arsenic in Pickling Solutions."[24]

Burgess's interest in the corrosion of iron and its alloys was stimulated greatly by the awarding of the Carnegie grant in December 1904 (Chapter 13). Although he failed to mention the subject of corrodibility of electrolytic iron and its alloys in his petition for the grant, it is included in the outline of the investigation in his first report dated September 25, 1905. The investigation with Engle on the corrosion of iron with acids was conducted at least in part under the grant.

The many alloys of iron made under this grant (see section on Electrolytic Iron and Alloys) were subjected to both acid and atmospheric corrosion tests. The work was summarized by Burgess and Aston in their paper on the "Influence of Various Elements on the Corrodibility of Iron."[19] It was based in part on a thesis by B. F. Bennett[208] who made atmospheric corrosion tests in Madison over a period of 162 days on small strip samples. These were then cleaned, weighed and subjected to the action of a 20% sulfuric acid solution for one hour. The samples included unalloyed electrolytic iron and alloys of iron with aluminum, arsenic, cobalt, copper, lead, manganese, nickel, selenium, silicon, silver, tin and tungsten. An important conclusion reached in this paper is that small copper additions to electrolytic iron greatly decrease its rate of corrosion. Although several other elements increased the corrosion resistance of the iron, copper was emphasized because beneficial results could be obtained without prohibitive cost of addition agent. Unalloyed pure electrolytic iron showed nothing striking in its resistance both to the atmosphere and acid and, therefore, "it does not fall in line with the commonly accepted view that a close approach to purity would indicate a high resistance to acid attack." The conclusion is also reached that the tests "do not seem to point to any quantitative relations between the acid and atmospheric corrosion." At that date there was a considerable

controversy about the relation of acid corrosion to atmospheric and other types of corrosion.

Dr. Allerton Cushman was present when Burgess presented this paper to the American Electrochemical Society and, as expected, he did not permit the conclusions to go unchallenged. This was to be expected in view of their relations at that time, though both were consultants for the American Rolling Mill Company (Chapter 13). He discussed the paper at length and attacked it in several ways, one of the arguments being that experimental results obtained on small samples would not hold true for products of commercial size. Bradley Dewey, then associated with the American Sheet and Tin Plate Company, and having full knowledge of the outcome of Buck's first corrosion experiments with full-size sheets of copper-containing steels, revealed that Buck's conclusions, still unpublished, were in accord with those reached by Burgess and Aston. Furthermore, the results obtained with full-size sheets duplicated those obtained with small laboratory-size samples. Unfortunately for Cushman and his client, he would not recede from the position that he originally took on copper-bearing irons and steels in the face of overwhelming evidence to the contrary.

The above controversy with Dr. Cushman was the natural outcome of a conflict between the two that had started several years before (Chapter 13) when Burgess suggested that the presence of a small amount of copper had given the American Ingot Iron its advertised corrosion resistance and, contrary to Cushman's recommendations based on the electrochemical theory of corrosion, it would be a mistake to keep the copper out of the iron. That conflict was not limited to the copper-in-iron controversy. It also had to do with the effect of manganese and other impurities in iron and steel, such as slag and oxides. Cushman maintained that manganese was a harmful impurity and Burgess also took issue with him on this.

Burgess, with the able assistance of Aston, had shown conclusively that purity of iron alone was insufficient for best results where corrosion resistance was required. The Newburyport bridge links demonstrated this. It was again demonstrated by some old durable iron that Schildauer also sent to Burgess from Panama and which caused him to write to his former pupil on September 24, 1912 as follows:

> I note that Dr. Cushman* and others have referred to this material as an instance of the greater durability of old iron. I think that some unwarranted deductions have been drawn as to why the older French material has shown the greater durability. An analysis of the iron itself shows it to be decidedly impure and of a very low grade from a mechanical standpoint. It is brittle and full of slag and oxide. From the electrolytic theory of corrosion of iron this material ought to have corroded long ago.

Within a few weeks after writing to Schildauer Burgess wrote a report[95] for the Laboratories entitled "Methods of Reducing Iron Corrosion." The first two paragraphs follow:

*Cushman had described this material in an article on corrosion in *The Iron Trade Review* for May 23, 1912 but had not mentioned the slag and oxide.

> The electrolytic theory of iron corrosion has now attained almost universal acceptance, but it has not led, however, to the progress that was expected in applying this theory to methods of preventing corrosion. There is disappointment in the fact that the theory has produced no methods of eliminating corrosion; and it is pertinent to ask whether for this failure theory must be held to task or whether the problem is impossible of solution.
>
> To a certain extent the electrolytic theory is at fault, but to a far less extent than is the abuse of the theory by misinterpretation. The theory says that non-uniformity, impurity and segregation set up local galvanic couples. These couples cause corrosion; and the converse, is of course, implied that high purity, uniformity and homogeneity imply absence of corrosion. As a practical answer to this proposition, we find that pure iron (at least iron in as high a state of purity as is possible to get) does rust. We have numerous cases of iron which have shown exceptional longevity, which upon microscopic examination shows excessive heterogeneity. We find numerous examples where a highly impure iron has high resistance as compared with other forms of iron and steel. It is observations such as these that have served to cast some doubt upon the applicability of the electrolytic theory.

Burgess aptly expressed his conclusions in this report also about the factors that he believed were of importance in the corrosion of iron by stating "that a *factor* of *greater importance* than internal heterogeneity (of the iron) is *external heterogeneity* or any inequalities or non-uniformity in the surrounding medium. . . . Purity (of the iron), and homogeneity associated with purity are important factors in retarding the incipient rusting, but when rust once starts the purity then is of minor importance." In another report he noted that purity is important but "only a step in the right direction."

There also was a controversy about the ferroxyl test as applied to iron which had been developed in about 1906 or 1907 by Cushman and Walker. It was being used by Cushman particularly to prove his contentions about the electrochemical effect of impurities in iron and steel by showing the presence of anodic and cathodic points or areas. It was a "beautiful, spectacular and convincing test" and was used effectively by Cushman in demonstrating the effect of impurities in iron and steel in setting up electrolytic couples that caused corrosion. Burgess was not convinced and had a study made of the test. It showed that the test is unreliable unless it is carried out in the absence of air. The depolarizing action of air in contact with the surface of the gel used may completely mask the difference in potential caused by heterogeneity of the specimen.[214] Burgess used this as an example of the greater importance of the external heterogeneity.[95]

The records show that by the end of 1911 Burgess was pretty well convinced of the increased corrosion resistance resulting from the addition of small amounts of copper to relatively pure iron but he had little evidence that the copper would be effective in the ordinary mild steels used extensively for sheets and fence wire. Within a year D. M. Buck proved that it was relatively more effective in the ordinary steels than in the purer irons. Burgess was encouraged by Prof. W. H. Walker of Massachusetts Institute of Technology in his controversies with Cushman though Walker was a strong believer in the electrochemical theory of

corrosion and had worked closely with Cushman. Walker was not swayed by prejudices and had the same keen powers of analysis that were possessed by Burgess. Burgess received encouragement in 1911 by the publication of the Walker paper on "The Marked Influence of Copper in Iron and Steel on the Acid Corrosion Test."[216]

Early in 1913 Walker gave Burgess credit for showing that "iron free from all contaminating elements which could segregate or produce a lack of uniformity, does not withstand rusting so well as the same iron to which has been added a little manganese or copper or nickel."[215]

Although Burgess discontinued active work on the copper-steels and other alloy steels the first-hand information he obtained during his active association with the alloy work was used to good advantage in serving clients of C. F. Burgess Laboratories.

For example, when the Malleable Iron Range Company of Beaver Dam, Wisconsin, came to him with severe corrosion problems encountered in cooking ranges—particularly in flue constructions— he was able to mitigate greatly the corrosion difficulties by suggesting the use of copper-bearing steels and copper-containing malleable iron, some of which contained considerably larger percentages of copper than normally are required to resist atmospheric corrosion.[213]

Burgess was interested in the theoretical as well as the practical aspects of the corrosion problem. He discussed some theoretical aspects of iron corrosion in a 1912 paper entitled "Does Pure Iron Rust?"[29] Students in the Applied Electrochemistry and Chemical Engineering courses at the University of Wisconsin did thesis work on various aspects of this problem.

The pitting problem was studied intensely by him. It was forcefully brought to his attention while he was serving on the Railroad Commission (Chapter 14). He was in direct contact with the various public and private utilities in the State and their engineers often sought his advice on their various problems, and these included various types of corrosion problems, including that of pitting by rust. The writer (class of '10) recollects the stress that Burgess put on that problem when lecturing to his classes on certain phases of electrochemistry and chemical engineering while the writer was an undergraduate. Burgess would discuss at length those problems on which research currently was being done in the department and which was yielding interesting data. In one of these lectures dealing with various aspects of corrosion phenomena, he demonstrated by means of the experiments then under way the important part played by the rust formed at the surface of the iron in promoting pitting. He demonstrated the anodic effect observed with wet rust and how it could be obtained also by other means. He showed that it was a case of relative access of oxygen to the metal underneath and that the iron surface was cathode where the oxygen had more free access, the other surface covered by the rust being anode. The cell thus set up caused pitting to occur. Burgess apparently never published this work though it is discussed at length in a Burgess Laboratories report[95] and touched on in at least one other. These lectures were given and the reports written a number of years ahead of the first publication by

others of this explanation of the mechanism of pitting. However, he did allude to it in answering Cushman's discussion of the 1912 paper on the "Influence of Various Elements on the Corrosion of Iron"[19] (p. 258), where he said:

> In attempting to prevent deterioration by rust there should be recognized a difference between the problem of preventing the initial rusting and the problem of preventing the pitting action to which Dr. Cushman has called attention. Pitting is dependent upon an acceleration action produced by rust accumulation.

The phenomenon of pitting was stressed in a joint paper with Aston in 1912 entitled "The Rate of Rusting of Iron and Steel."[25] In that paper the various factors influencing the rate of rusting are discussed. It is particularly pointed out that impurities may both accelerate and retard rusting and that heterogeneity of structure of metal, generally supposed at that time to be antagonistic to durability, was a factor of secondary significance and was overshadowed by other factors.

When Burgess answered Cushman's discussion of the paper on the influence of various elements on the corrodibility of iron[19] (p. 258) he pointed out that when pitting occurs "if a barrier can be interposed so that a rust spot will spread out rather than become deeper, there will be a minimizing of the damaging action. The writer believes that slag and other non-conductive impurities frequently found in iron, under certain conditions, constitute such barrier." He had observed that this actually occurred in several examples of badly pitted tank-plates that had been submitted to him for examination. As a result of these observations he devised a "pit-proof" composite iron structure in which he replaced the slag layers with thin layers of a metal more resistant to corrosion than iron, for example, nickel. He was granted a patent on this composite metal.[116]

Although Burgess continued to be interested in corrosion problems, his was not an active interest after 1913. His advice was often sought for and given in corrosion problems thereafter but he never returned to an active period of research of the character that was done previously.

As a result of his later association with Prof. S. W. Parr of the University of Illinois in a coal-coking development (Chapter 29), he became much interested in the acid-resistant Illium alloy that Parr had developed and patented[271] and which he was making and selling through the Standard Calorimeter Company. As a result the Burgess-Parr Company was organized in 1928 (Chapter 31) to succeed the earlier company and it continued the Illium alloy work. Burgess always was much interested in this alloy because of its excellent corrosion and acid-resistant properties, and he devoted considerable time to its further development and uses. He did this in the expectation that some day it would be the basis for an expanded business in special types of corrosion-resistant alloys based on the work he had done at the University.

In 1909 Burgess became involved in the controversy over the value of protection offered by zinc coatings applied to iron or steel by the sherardizing process which had been introduced into the United States

several years previously by Sherard Cowper-Coles of England. At the request of the United States licensee under the Cowper-Coles patents, the U. S. Sherardizing Company, Burgess carried on some laboratory investigations on the coatings produced by the process and made comparisons with the competitive hot and cold galvanized coatings (Chapter 21). The sherardized coating consisted largely of a zinc-iron alloy and Walker[217] had reported that this alloy, $FeZn_7$, was *electronegative* to iron (zinc then was designated as positive to iron) and instead of protecting the iron, had the undesirable opposite effect. Because of Walker's standing this was a highly damaging statement. Burgess[60] showed that the zinc-iron alloy constituting the sherardized coating was not electronegative to iron and Walker[218] subsequently acknowledged his error in measuring the potential of the alloy. There was a considerable controversy at the time. Following are Burgess's conclusions about the sherardized coating as published in the *Sherardizing Magazine*:[60]

> The potential of the alloy coating is in the neighborhood of 0.20 to 0.25 volt as against 0.50 volt for pure zinc. It fulfills therefore the requirements of being electro-positive to iron and it is probable that the slower rate of corrosion as compared to the more electro-positive forms of zinc, is due to the fact that it is not electro-positive to a wasteful degree. In the potential measurement, therefore, we see a very definite reason why a sherardized coating is more resistant to galvanic action than are other forms of zinc.

Miscellaneous Corrosion

A practical application of the overvoltage phenomenon was made by Burgess during the first World War to cut down dry cell manufacturing costs when the price of zinc had skyrocketed—it rose to over 25 cents per pound. Because the hydrogen overvoltage of tin and lead is sufficiently high to stop galvanic action when in contact with zinc he substituted terne plate (tin plate could have been used) bottoms for zinc bottoms in 6-inch cells[137] and thereby effected a worthwhile cost saving and a saving of a critical material without affecting appreciably the performance of the cells. However, this was not the first overvoltage application that he was interested in. In about 1910 he became financially interested in another practical application in the form of a silver-cleaning pan construction[34,219] (Chapter 20), though invented by others (C. Hambuechen and J. D. Phillips) than himself.

Burgess also made use at an early date of the inhibiting effect of the chromate film to lessen corrosion. In 1914 the first dry cells in which a chromate film was formed on the zinc can were made and sold by Burgess Laboratories for the purpose of decreasing local action and consequently lessening the rate of deterioration while standing on dealers' shelves or during the intervening time between periods of use by the ultimate consumer. The chromate protective coating is still being used by Burgess Battery Company. (See section on Batteries).

Burgess was much interested in what he called "controlled corrosion" (Chapter 34), that is, he shaped metals by subjecting them to anodic action. He carried on much experimental work on this hobby in 1940-1 as described in the section on Electrochemical Devices.

Section VI

ELECTROCHEMICAL PROCESSES

BURGESS early became interested in electrochemical processes for the production of chemical compounds, particularly because he believed that such processes offered him an opportunity to get into commercial work. During the time that he was an undergraduate in the University important electrochemical processes had been established by industry and there appeared to be many further opportunities which must have beckoned him on.

As a result of his investigation of the developments which had been made and of the literature on the subject he expressed the following opinion in a paper given by himself and Hambuechen in 1903:[47]

> There is probably no field of industrial activity in which such a large percentage of the literature relating to it possesses the properties of inaccuracy, incompleteness, and absolute untruth as does applied electrochemistry. This condition arises through various characteristics of the writers, including excessive enthusiasm leading to premature declaration, incomplete knowledge of the subject under treatment and even the apparent intent to mislead the public. The patent literature is especially characterized in the exhibition of these traits, and as printed frequently bears internal evidence of the leading scientific and technical societies. Erroneous statements published, perhaps in all sincerity, by overenthusiastic or insufficiently informed observers are almost invariably allowed to stand uncorrected, largely through the natural reluctance which one has of admitting that he was wrong, and by reason of that same trait of humanity which causes a man, after he emerges from the tent of a side-show where he has been swindled, to allow his neighbor to pay his money and enter without a word of warning.
>
> Electrochemistry being a new and little understood field, has been a fertile one for fraudulent schemes. A list of such would be a lengthy, interesting, though perhaps a familiar one. A similar list of electrochemical applications which have been published through no fraudulent motives, but which have failed through unforeseen conditions, would be much larger; and it is a noteworthy fact that our literature is almost entirely lacking in publications setting forth the reasons for failure of previously supposed successful processes. Such publications would be of especial value as a guidance to others and would be of advantage in promoting industrial progress by calling attention to problems which need solution, such problems as an experimenter could discover otherwise only by lengthy preliminary research.

The development in the early 90's of a successful commercial

diaphragm-type electrolytic cell for the production of chlorine and caustic soda (Chapter 14) probably was a factor that caused Burgess to be interested in this industry. However, his interest was largely academic until 1907 with his students working on problems related to this industry. For example, one of his students, W. R. Mott, investigated the single potentials of the halogen elements,[236] and another, G. I. Kemmerer, investigated the cathodic disintegration of carbon in fused sodium chloride.[237] As a by-product, however, of his laboratory work he developed the process for the electrolytic cleaning of metals which is described in detail in the section on Metal Coating and Electro-refining. In later years he stated that this was his first important discovery.

Following closely after the electrolytic cleaning discovery was the electrolytic process for the removal of surplus brazing spelter from steel bicycle frames (Chapter 7). Burgess quickly solved this problem when it was put up to him on the last day of 1898 by his instructor associate Murray C. Beebe. He applied his knowledge on the passivity of iron in nitric acid. He solved the problem by making the brazed bicycle frame anode in a sodium nitrate solution,[48, 49, 62] whereby the excess brass was removed leaving the iron unattacked. The two young instructors acted quickly. Within 15 days they were contacting bicycle manufacturers and by February 15, 1899 had started a man calling on bicycle manufacturers throughout the eastern United States. A considerable number of licensees were obtained. The burden of attending to the details of this business proved too great for the two men and it was turned over to the Hanson & Van Winkle Company who thereafter licensed and installed the "Burgess Process." The story of this dramatic development is told in Chapter 7. This stripping process was also applicable to the removal of other metals and alloys including silver, copper, tin, zinc, lead and cadmium.[48] A patent application was filed but a patent was not obtained because of the prior art. The process was soon universally used in industry.

During the period that Burgess was developing the electrolytic cleaning and debrassing processes he was also carrying on experimental work on the electrolytic production of lead compounds useful as paint pigments. He was particularly interested in them because of the large volume of business potentially available. In a manuscript (which apparently was not published) he states: "a more promising field for such application, in which much experimenting has been done and in which comparatively little progress seems to have been made, is in the use of electricity in the production of paint materials. Paint manufacture is one of the greatest and more important of the world's industries and any improvement which can be introduced into it will be of correspondingly great value." He then states that much work had been done and many patents had been issued but the manufacturers still continued to use the old processes, some of which had been used for centuries. He then goes on to conclude: "In spite of the lack of commercial success of such processes there is no fundamental reason why electricity should not be a valuable adjunct to the pigment manufacturer if he will only appreciate

the limitations and conditions under which the electric current must be used."

Burgess did not limit himself to lead pigments as the records show that he studied a large variety of pigments. He was particularly impressed also with the possibility of producing a copper carbonate pigment electrolytically. Of the lead pigments, he studied especially the production of white lead and lead chromate. He used as the basic reaction the anodic corrosion of lead in a nitrate solution to produce lead nitrate, which in turn was treated to produce the required pigment compounds. A small pilot plant which was set up at the University is described in a Burgess and Hambuechen paper.[47]

Burgess did much work on the electrolytic white lead and lead chromate processes prior to 1901 and continued this under the arrangement with the Johnsons (Chapter 11). He finally came to the conclusion that the electrolytic manufacture of white lead showed no economies over the well-established processes for its manufacture and thereafter concentrated his efforts on attempts to commercialize the electrolytic production of lead chromate. A number of manufacturers showed interest in it but none of them was convinced sufficiently to install the process.

Under the Johnson arrangement he had Hambuechen carry on an investigation of the alternating-current electrolysis of fused sodium hydroxide to produce metallic sodium.[222] In this process an aluminum diaphragm was used in the cell and it was based on the knowledge gained with the fused sodium nitrate aluminum rectifier development which is described in the Electrochemical Devices section. The experimental work showed that metallic sodium could be made in this way without any particular difficulty.

Burgess had his first industrial opportunity in the field of electrolytic chlorine and caustic alkali production when he was employed during the summer of 1907 at the Oxford Paper Company, Rumford Falls, Maine, to assist in the development and installation of the Jasper Whiting mercury-type cells[262] and in the development of the bleach plant (Chapter 14). In the course of this work he inspected a considerable number of the electrolytic chlorine and caustic plants that were then in operation in the United States and Canada. He also studied the bleach-making operations. Because of his keen powers of observation and analysis Burgess acquired a comprehensive and valuable knowledge of the industry during that summer. He and Whiting worked out and patented[106] a method for efficiently oxidizing the sodium dissolved in the mercury in the electrolysis of the salt. Subsequently, during the following decade, Burgess's services as a consultant in the electrolytic production of chlorine and caustic and in the production of bleach were sought after and obtained by a number of companies, particularly those engaged in paper making. In addition, he was an expert for the defense in Dow Chemical Company v. American Bromine Company and Arthur E. Schaefer (filed in November 1916)[308] involving bromine and bromide manufacture (Chapter 29).

Because of his familiarity with the electrolytic chlorine industry Burgess became interested in the sterilization of water by chlorine. He

was particularly interested in the use of nascent chlorine for this purpose because of its effectiveness. At the time that his Laboratories were starting the manufacture of miniature dry cells on a small scale he became intrigued with the idea of using a flashlight cell to sterilize drinking water with chlorine on a drinking-glass scale with dry-cell operated sterilizing equipment that could be carried in the pocket of the user. At that time sterilization of drinking water supplies by chlorine was in its infancy. He devised such a pocket-size dry-cell operated sterilizer[121, 293] (Chapter 22). In this clever device a small disk of filter paper containing a small amount of common salt was held by spring pressure between two electrodes. The electrodes were then immersed in a tumbler of drinking water and the current turned on for a minute or two. The chlorine thus generated was highly effective in sterilizing the water, tests indicating that its effectiveness was due at least in part to its nascent condition. The salt in the disk was insufficient to affect the potability of the water. The device was used by a number of explorers who used hand-operated generators instead of dry cells. However, it never was exploited commercially.

Burgess's interest in the electrolytic production of chlorine, caustic soda and hypochlorite and its wide range of application is again shown by his relations with the Valhalla Company of Chicago from 1911 to 1917. This company produced small electrolytic bleach-making outfits for laundries and for swimming pools, some units being portable. As in the dry battery field, portability appealed to him and he devoted much of his time to the problems of this Company, even preparing technical advertising copy. He was keenly interested in the unusual technical problems that arose which usually were somewhat different from those encountered in large installations.

Because of Burgess's work on electrolytic processes he was interested in the efficiency of electrolytic cells and how this should be determined. This was the subject of a paper in 1898.[50]

Section VII

ELECTRIC FURNACES—ELECTROMETALLURGY

THIS section does not include work done on electrolytic iron and its alloys which is described in a separate section.

Electric furnaces received the attention of Burgess early in his University career, no doubt because of the rapid expansion at that time of industries that utilized them. Such furnaces were among the first pieces of equipment purchased when the applied electrochemistry course at the University of Wisconsin was first expanded in 1895-96 (Chapter 3). In an article[304] which describes the equipment in the electrical engineering laboratories at the University at that time, the following note appears: "Opportunities for experiment in the electrolysis of fused compounds, and of melting and electrolyzing difficultly fusible substances by means of the electric arc, are furnished by means of two Borchers furnaces and a Moissan furnace." For a number of years, however, the electric furnace work was hampered by the lack of a source of supply of sufficient electrical energy and it was not until 1904 that 300 kilowatts were available (Chapter 16).

Burgess studied particularly the utilization of the electric furnace in the smelting of zinc sulfide ores. No doubt the proximity of the important zinc and lead mining districts in southwest Wisconsin stimulated his interest. In addition, the separation of the zinc sulfide from the accompanying iron sulfide in the ores of that region was a problem that had to be solved in connection with the electric smelting and he did much experimental work on it. His work on an electrostatic separator is referred to in the section on Electrical Devices.

The men working under Burgess's direction on the electric smelting of ores and their pre-smelting treatment in electric furnaces published the results of their work largely under their own names. Most of the work was on zinc ores. The first of these papers on "The Electric Smelting of Zinc" by O. W. Brown and W. F. Oesterle[224] dealt with the direct electric smelting of zinc sulfide ore with lime and carbon to produce metallic zinc, calcium sulfide and carbon monoxide. This same principle was applied to the smelting and reduction of the sulfide ores of molybdenum, antimony, lead, copper, iron and nickel as reported by Brown[225] the following year, the most encouraging results being obtained in the reduction of the molybdenum sulfide. The separation of the iron sulfide from the zinc sulfide in the zinc ore without forming oxides was an important step in the work Burgess was doing on the electric smelting of the zinc sulfide ores and is described by Kowalke [226] in 1908 in a paper on the "Electric

Furnace Conversion of Iron Pyrites into a Magnetic Form." The last paper on this subject was published by Ruhoff in 1912 and was entitled "Magnetic Separation of Zinc Iron Ores Found in Southwestern Wisconsin."[233]

Following his efforts to produce metallic zinc by the direct reduction of zinc sulfide he developed a process in which the metallic zinc was produced by reducing zinc oxide vapors with incandescent carbon. This process depended upon the discovery that zinc oxide could be volatilized from zinc ores at temperatures above 1100°C. The process as described in a patent issued in 1913 to Burgess[113] (application filed on October 8, 1909) provides for a furnace in which the zinc oxide is heated to above 1100°C. by electrical means and its vapors passed through carbon heated electrically to incandescence. The volatility of zinc oxide is the subject of a paper by Kowalke[227] in 1912. Although some interest was shown by zinc producers in the patent, the records indicate that it was not used commercially with Burgess's consent.

Much of the electric furnace work done under Burgess at the University electrochemical laboratories was by Prof. O. P. Watts. Titles of papers published on this work include "A New Silicide of Molybdenum,"[228] "The Preparation of Calcium Alloys for Aluminothermic Work,"[229] "Further Experiments with Calcium Alloys as Reducing Agents,"[230] and "An Investigation of the Borides and Silicides."[231] Hirsch[232] also carried out work on the preparation and properties of metallic cerium under Burgess. Electric furnace work done in connection with electrolytic iron and iron alloys as described in that section is found in papers by Watts.[202, 205]

In 1905 Burgess gave a paper on "The Present Status of Electric Furnace Working" before the Western Society of Engineers[58]. He had previously touched on this subject in an article in the *Wisconsin Engineer*[59] when he wrote on "Some Uses of Electricity in the Working of Metal."

A patent was issued to Burgess in 1908[105] (application filed on May 31, 1906) on a method of separating refractory articles in electric furnaces to keep their surfaces well defined. Paper was the preferred material. He apparently never received any financial return from this invention though he told the writer that the claimed method became standard practice in the industry.

Although Burgess had not been directly connected with the manufacture of calcium carbide he was retained as an expert in 1910 for the defense in Union Carbide Co. v. American Carbolite Co. involving patents covering a process for making the carbide and the product of the process.

The activities of Burgess in the electric furnace field decreased after about 1910 and particularly after he became firmly established in the manufacture of flashlight cells in 1913. Nevertheless, electric furnaces always interested him and throughout the rest of his life he gave electric furnaces prior consideration whenever any type of heating or furnace problem arose. Furthermore, he served as a consultant in the zinc metallurgy and electric furnace fields for a number of concerns in the decade after 1910.

Section VIII

ELECTROCHEMICAL DEVICES

WHEN Burgess investigated the subject of measurement of insulation resistance for his thesis work in fulfilling the requirements for his electrical engineering degree in 1898[57] he found that the Lippmann capillary electrometer was better suited for this purpose than any other type of instrument then available. He found it, however, to be too fragile for industrial work. Nethertheless, he was so impressed with its possibilities that he developed a portable and rugged model which he described in a paper before the A.I.E.E. (Chapter 5) in the summer of 1898.[56] Although considerable interest was shown following the presentation of the paper, he was unable to interest instrument makers. He supplied his improved instrument to a number of users (Chapter 15) of insulated electric cable and they commented very favorably on it but he never made any appreciable progress in his efforts to make a business of it.

Burgess never lost interest in the capillary electrometer and at intervals he would discuss it with the writer and express his firm conviction that a real use would be found for it. Then in 1944 (Chapter 39) it seemed as though his dreams and hopes were on their way to fulfillment—for he finally had an idea which could bring the capillary electrometer out of its almost half-century of retirement. His hunch proved correct—when the experimental model was tested it gave evidence that the capillary electrometer, as he constructed it, would find use as a transducer in phonograph pick-ups and in microphones. Burgess, though he had the extreme satisfaction of listening to brilliant reproduction of music by a phonograph in which the usual transducer of the pickup was replaced by his "capillary", lived only long enough to start the necessary long, tedious and costly program of research and development which he had learned usually was necessary to bring a laboratory development to commercial production with the odds 10 to 1 against eventual success. Shortly before his death the first patent application was filed. It later issued as a patent.[156] (At this time, May 1948, the writer is optimistic enough to believe that eventually the "capillary" is going to prove that Burgess's hunch was a good one).

At about the time that Burgess began to doubt that the insulation resistance tester would ever amount to anything industrially he was investigating the possibilities of the aluminum rectifier. At the turn of the century there was a rapidly growing demand for a small portable rectifier for the reason that all new electric power installations for general distribu-

tion utilized alternating current. Direct current was still needed for many uses, particularly for the charging of the rapidly mounting number of storage batteries that were being put into service especially in the popular electric "horseless carriage." The aluminum rectifier seemed to be the solution to the problem but it still was an unsatisfactory device in spite of the large amount of research work that had been done by many investigators. Burgess no doubt was particularly interested because of its commercial possibilities and had Carl Hambuechen work on it as a thesis investigation, starting in the latter part of 1900. Hambuechen did not confine his investigation to the aqueous electrolytes that had given such poor results. He turned his attention to fused electrolytes and found early in 1901 that the rectifier performance was greatly improved through the use of a fused alkali metal nitrate electrolyte with iron and aluminum electrodes. A practical rectifier seemed to be in the offing.[257] Burgess also was of this opinion and intensive work was done on this new construction (Chapter 8) and it was continued under the Johnson arrangement (Chapter 11). Whereas a patent was granted to Hambuechen on the use of the fused electrolyte[235] Burgess contributed to the further development of the rectifier by devising and patenting in conjunction with Hambuechen a method for heating and fusing the electrolyte[102], and (without Hambuechen) devising systems for electrically connecting together a multiplicity of the rectifiers to generate a non-pulsating rectified current on which two patent applications were filed. One issued as a patent[104] but the other eventually encountered difficulties in the Patent Office in the form of a five-party interference. This last application contained claims that were not limited to the Hambuechen fused salt rectifier but were applicable to any type of rectifier. It is not surprising, therefore, that Burgess found himself in an interference involving such men as Steinmetz and Weintraub of the General Electric Company and Thomas of the Cooper-Hewitt Company (Chapters 11 and 14), the latter company being about to market its mercury-vapor arc rectifier. In the meantime Burgess was endeavoring to develop a rectifier without "bugs" so that manufacturing and selling could be started.[93] When the Johnsons quit the arrangement at the end of 1903 Burgess found he could not afford to continue the development and finally made arrangements with one of the parties in the interference to take it over. This manufacturer did little with it so that in 1905 Burgess had to cancel the arrangement. At about this time Burgess, although he found himself ahead of all the parties of the interference insofar as dates were concerned, was denied a patent because he had delayed filing his patent application too long so that an obscure foreign publication[289] disclosing the invention antedated his filing date by slightly more than two years. The irony of it was that Burgess's date of conception and written description preceded the foreign publication date by more than two years and his reduction to practice preceded it by a few days. Without adequate patent protection Burgess dropped further work and finally sold the three patents that had been issued, to the General Electric Company (Chapter 14). The electrolytic rectifier was first described by Burgess and Hambuechen at the first meet-

ing of the American Electrochemical Society in 1902[53] and later in the year in the *Wisconsin Engineer*.[54] There were further ramifications of this development, one being the aluminum electrolytic condenser[223] and the electrolysis of sodium hydroxide with alternating current[222] (described in the section on Electrochemical Processes). As a result of their extensive experience with aluminum in the rectifier development Burgess and Hambuechen published their laboratory observations on this metal.[92]

Many years later Burgess became interested in the anode instead of the cathode in the field of electrolytic metallurgy, particularly the removal of metal by electrochemical means in contrast to the plating or building up of metal. He pointed out that when metals are drilled, filed, machined, etc., the operation is one of brute force and violence and is a crude one at best. In contrast metal may be removed quietly and without injury to the remaining metal by electrochemical means and at small energy cost. He made a hobby of this "controlled corrosion" (Chapter 34) and did a large amount of experimental work. He found that he could control to a high degree the electrochemical removal of metal by making the particular area to be affected the anode in a rapidly moving stream of electrolyte, such as a jet, with the cathode closely adjacent. He found that he could drill holes in the hardest of steels and alloys by using a jet cell of this kind operated by his favorite source of electrical power—the dry cell. He did not confine his experiments to the drilling of holes but was able to fashion hard steels and alloys into various shapes—one of his favorites being that of a screw thread made by removing the metal between the successive spaced-apart coils of a rubber band wound on a rod of the metal. Burgess found, however, that here again he could not patent his "invention" because of the earlier published work of another foreign scientist. He gave publicity to the device by demonstration and a descriptive pamphlet[55] at the October 1941 Chicago meeting of The Electrochemical Society, where it attracted much attention. Burgess subsequently was again flooded with letters of inquiry and it seems probable that some practical uses for the device were found.

In his early work on the development of electrochemical processes Burgess found need for rapidly measuring electrolytic resistances. He described such a method and device in a paper before the American Electrochemical Society in 1907.[63]

After assisting a manufacturer in overcoming difficulties experienced in operating electrolytic cells for the production of hydrogen and oxygen from water, Burgess, prior to 1905, did a considerable amount of work on the development of an improved cell. The correspondence indicates that several times he was on the verge of going into the manufacture of such cells (Chapter 18). This project finally was dropped and nothing was published about it.

The miniature dry-cell operated sterilizer developed by Burgess for treating a tumbler of drinking water is described in Section VI.

Section IX

ELECTRICAL DEVICES

BURGESS was trained primarily in electrical engineering and during his first years as an educator he taught some classes in electrical engineering in addition to those in electrochemistry (Chapter 15). It is not surprising, therefore, that he maintained an interest in electrical devices throughout his life and did research work in this field. His contributions to the electrical engineering literature are limited to patents. Although flashlight cases and dry cell devices may be classified under the heading of this section his work on these is described in the section on Batteries.

In 1901, Burgess and Budd Frankenfield, also of the Electrical Engineering Department, applied for a patent on a method for regulating and controlling the current and potential in an alternating electric current circuit or system of circuits. The method used depended upon the principle of variable inductance in which the circuit included "an inductive resistance, as a coil of wire wound upon a core of paramagnetic material, as soft iron." A companion application was filed early in 1903 and both patents issued late in that year.[101, 103] These patents were sold.

On September 15, 1903 Burgess requested his patent attorneys to determine whether a certain heating apparatus operated by alternating current was novel. He described this device as a transformer in which the secondary consisted of one single turn of low resistance whereby a heavy current at low voltage was induced in it. He was advised that the principle was not new but that the specific application and construction were new. Apparently a patent application was not filed though a modification was used and patented[102] for heating the fused electrolyte in the electrolytic rectifier (see section on Electrochemical Devices).

During his early years as instructor at the University Burgess found that the instruments and equipment then available often did not meet his requirements. In such cases Burgess designed his own electrical equipment to do the required job as stated in the article in *Electrochemical Industry*[52] in 1904 describing the electrochemistry course and equipment at the University. The equipment so designed was built in the Mechanism Department of the College of Engineering in charge of E. H. J. Lorenz. Apparatus so designed and constructed, as listed in

that article, includes special potentiometers, capillary electrometers, devices for measuring electrolytic resistance and several successful types of rheostats in which carbon rods and graphite were used as the contact and resistance elements. In one form carbon rods were used; in a second form carbon blocks were built up in the form of a knife-blade switch; and in a third form the sliding contact was made by filling in a circular slot cut in a slate or stone slab with a mixture of graphite, pumice-stone and a binding material, which mixture could be used up to temperatures of 150°C.

On January 9, 1905, Burgess wrote to his attorney describing "an apparently new method of separating materials by means of a high tension alternating pressure." He suggested that it might be used in the separation of ores and similar materials. A sketch accompanied the letter and the apparatus was described as follows:

> The apparatus here shown consists of a belt rendered conductive either by the application of graphite, electro-coppering or other suitable means. This belt is inclined so that one edge of it is somewhat lower than the other. Above this belt, as shown, is an insulating plate such as glass, and on top of this plate is a conductor of tinfoil or other sheet metal. The belt and the electrode are connected to an alternating pressure of suitable value, such as 10,000 to 20,000 volts. The material to be separated is first sized by means of screens and then fed in a continual stream to the upper left hand part of the belt. As it passes under the upper electrode the particles are set into vibration, jumping up and down rapidly and therefore working toward the lower edge of the belt. The extent of the motion depends upon the pressure applied and also upon the nature of the materials. By a suitable adjustment between the upper electrode and the belt and of the pressure applied a selective action may be readily obtained so that one constituent of the mixture alone is set into vibration and works down to the lower edge of the belt, and as the material passes out from under the electrode a more or less complete separation is effected. By this means it has been shown possible to concentrate to quite a high degree a mixture of zinc and iron sulphides. Monazite sands and other similar materials are even more readily separated.

Burgess stated that he was not able to determine definitely what properties of the material were being utilized, that is, whether it was electrical conductivity or inductive capacity although he was inclined to believe it was the latter. After the search was made his attorney advised him that it looked as though the device was not anticipated.

Several months later Burgess described another new type of magnetic separator that he had devised. A patent was not issued on either of these inventions and the record does not show whether patent applications were filed.

Though Burgess severed his connection with the electrical engineering department of the University of Wisconsin in 1905 when the chemical engineering department was formed, nevertheless, a thesis was written in 1909 under his direct supervision which related to electrical equipment. The subject of the thesis, "Some Types of Circuits for Voltage, Current and Power Control,"[247] apparently concerned prob-

lems encountered in the electrochemical and electrometallurgical industries.

In 1912 a patent was issued to Burgess[111] on an application filed in 1910 on the construction of a vibrating device. There is no record of any industrial use of a vibrator based on this patented construction. However, Burgess was interested throughout his life in electric vibrating devices and it was not surprising, therefore, that when he saw the de la Torre vibrating device in 1939 as told in Chapter 37, he recognized its merit and became sufficiently interested in it to make an arrangement with de la Torre to develop it. The story of the Vibro-Tool which grew out of the de la Torre invention is fully told in that chapter.

While in England in 1931 Burgess concluded an arrangement to market in the United States a German-devised-and-made small glass-enclosed electric switch operating in a vacuum (Chapter 33). Experience with this switch indicated that there was a real market for a more practical form of a small snap-acting electric switch so that he encouraged the development of such a switch at the New York electronics laboratory of his Laboratories under the supervision of his son, Jackson Burgess. Here again it was his interest in small portable devices, so well exemplified by his interest in flashlight cells, which caused him to have more than ordinary interest in this development. As a result the Microswitch was developed and subsequently patented in 1934.[256] The Burgess Laboratories perfected this invention and marketed the switch which business was continued by the Micro Switch Corporation (Chapter 34).

Burgess's interest in electrical devices formed the background for his interest in the Thordarson Electric Manufacturing Company and his desire to help his old friend Chester H. Thordarson in 1936 (Chapter 28). He told the writer many times of his intense interest in electrical devices and particularly in transformers. The latter was in part due to his work under the Carnegie grant on iron alloys and particularly on their magnetic and electrical properties. He held strongly to the belief that there were opportunities for improving transformers and other devices depending upon electro-magnetic phenomena through the development of iron and other alloys and through the employment of new fabrication techniques, particularly, through the use of powdered metals. His interest in powdered metals was further stimulated by his association with Harry Ford of the Ferrocart Corporation of America. The work which was done on powdered metals by this corporation interested him sufficiently to become financially interested in it (Chapter 28).

Burgess devised during the 30's an electrical method for what he termed "welding wood." It was a method for quickly hardening thermosetting adhesives such as resins when used in joining pieces of wood, particularly thick pieces. His method avoided the long time required to bring the adhesive to the required hardening temperature when heat is applied in the ordinary way at the exposed surfaces of the wood. He cut this heating period to a minimum by inserting in the joint a perforated aluminum foil or equivalent material in addition to the adhesive

and then heating the foil by the passage of an electric current, thus quickly heating and hardening the thermosetting adhesive. The foil became a part of the joint. A patent application was filed but it was impossible to obtain the allowance of worthwhile claims.

Section X

EDUCATION

A LARGE part of Burgess's life was spent in the field of education, both in and out of the classroom, as told particularly in a number of the earlier chapters. The records left by him contain many letters and reports devoted to the subject as well as a considerable number of published papers.

Although Burgess always expressed a preference for industrial work he nevertheless became deeply interested in teaching and apparently made this as much of a research project as any electrochemical project that he undertook. His record as a teacher indicates that it was a highly successful project. It is not surprising, therefore, that within a few years after starting his teaching career in 1895 he was expressing forcefully his views on education both privately and publicly. He stressed particularly the desirability of basing the teaching of applied electrochemistry and chemical engineering on a basic engineering curriculum. His first publication on this subject appeared in the *Western Electrician* for March 20, 1897[64] though his article is devoted largely to a description of the electrolytic equipment and the courses of study in electrochemistry and electrometallurgy at the University. It points out specifically the justification for an electrochemical curriculum based on engineering in the following statement "while mechanical and electrical engineering go hand in hand, chemical engineering also joins hands with them in utilizing energy for industrial purposes."

Burgess subsequently wrote a number of articles on the teaching of electrochemistry and chemical engineering at Wisconsin. In these he described the equipment and the courses of study and stressed particularly the engineering foundation on which the courses were built. He stressed their practical nature and he was a staunch defender of this feature. The titles of these articles are "Relation of Chemistry to Electrical Engineering,"[65] "Electrochemistry at the University of Wisconsin,"[1, 52] and "Electrochemistry as an Engineering Course."[66, 67] He found that his views on the teaching of applied electrochemistry and particularly chemical engineering often were at variance with those of other educators, particularly with certain members[239] of the University faculty (Chapter 16). He found strong support, however, for his views at some of the leading universities that were offering similar courses. This conflict is illustrated in his vigorous "letter to the editor" of the

Electrical World and Engineer in 1901[68] protesting the previously expressed opinion of the editor that those directing the teaching of chemistry in American schools should have been trained in Europe in the atmosphere of Arrhenius, van't Hoff, Thomsen, Nernst and Ostwald (Chapter 8). Burgess held that useful production was more important and, therefore, the teaching should be based on superior American engineering that "produced" rather than on the highly theoretical European chemistry. Alongside the protesting letter the editor printed one from Woolsey McA. Johnson, well-known metallurgist, approving the editorial that provoked the discussion. Seventeen years later, during the first World War, in a talk (unpublished) before the Chicago Section of the American Institute of Electrical Engineers on March 25, 1918 he maintained that the advocacy of German chemical instruction prior to the war was a part of intensive German propaganda to convince the United States that it could not compete with the German chemical industry. He then said, "It (the propaganda) . . . can be easily disproved by just giving a little thought to what has been accomplished in chemistry in this country."

Burgess also wrote a letter dated May 4, 1901 to the editor of the *Electrochemist & Metallurgist* (England) who had written an editorial on what should be the training of the electrochemist. He stated that the course at Wisconsin had been "arranged with the idea that the remarkable progress in recent years in the utilization of electric current in chemical transformation has been due not to the new scientific discoveries, not to the new laws and principles which have been evolved, or to modern theories, but the development along strictly engineering lines." He again presented his views, which are quoted in Chapter 10, in a discussion of the Joseph W. Richards paper on a "University Course in Electrochemistry" before the American Electrochemical Society in April of 1902. On August 21, 1903 he wrote to the editor of *Metal Industry*: "I am a believer in the theory that as rapid progress in the sciences could be made by sticking closely to practical problems of immediate interest as by going into lines of investigation which can have their application only in the remote future."

During the decade following his "letter to the editor" Burgess gained much experience in education but he did not change his views on the value of a sound engineering training for students who wished to make industrial chemistry their life's work. He continued to believe in plenty of laboratory work "for it is in the laboratory rather than in books that he (the student) must obtain his knowledge." His experience in education was summarized in a paper published in 1911 entitled: "The Efficiency of College Training of Men for the Chemical Industries"[72] in which he tells how he believes courses of study in this field should be taught. In addition he defended the industrial type of research as frequently being "as distinctly scientific as that which is done to fulfill the requirements of a doctor's thesis," a conclusion which should be read both in the light of the status of industrial research in 1911 and the attitude of many scientists that industrial research would

continue to be less productive than that of institutions of learning which would also continue to be the greater producers of new and original matters. Burgess concluded:

> The writer asserts his belief that there is in general an inefficiency in the college training of men for industrial chemistry; that this training is largely in the hands of men who have an insufficient acquaintance with and appreciation of the requirements of the industrial workers; and that when educational chemists and industrial chemists finally come together on common ground, some of the present difficult educational problems will disappear.

He also questioned the teaching ability of many technical educators and at one time told his fellow-educators that he did not think a man knew his subject well enough to teach it unless he could explain it "in a manner intelligible to the average man," to which statement many objected strenuously.

Burgess not only had that appreciation of which he speaks but he also had the ability to instill enthusiasm in his students for their work. G. W. Heise[238] describes him as a "splendid teacher, characterized by his ability to stimulate in the student the necessary imagination and enterprise to enable him to apply his knowledge to some useful purpose." He usually substituted his practical experience for the classroom text book. He illustrated many important principles and drove these home effectively by relating interesting personal experiences "in the plant." This made for effective teaching because the students knew they were receiving sound information based on actual experience. Often he increased the interest of the students by going beyond the scope of the course when he, for example, gave practical advice not found in the books or when he dwelt upon unusual business details. He often used his current "outside" technical problems as a basis for classroom problems and discussions and this increased student interest (Chapter 19). But his teaching was not limited to the classroom (Chapter 18). Heise describes[238] one instance of his extra-curricular activities: "Doubly fortunate were those few who were permitted to join his last class, an informal non-credit seminar or conference of older and graduate students meeting at odd hours and in odd places, where we discoursed learnedly on overvoltage, theories of corrosion, cathodic depolarization in primary batteries, and the fundamentals of organizing and financing an electrochemical enterprise." He warned his students repeatedly of the obstacles they would encounter in practicing their profession though there were many opportunities. In a talk to his students on March 4, 1911 he concluded:

> I should much regret having even mentioned the possibilities in chemical engineering if it conveyed to anyone of you the idea that here is a field of opportunity without obstacles. It is in fact a field full of bumps, knocks, obstacles, where hard work, perseverance and experience are absolutely essential. It is not a "Klondyke" of opportunity where nuggets are to be picked up casually.

Burgess's interest in the teaching of gas engineering and his efforts to strengthen that division of the chemical engineering course are described in Chapter 17. This was the subject of much correspondence

with men identified with the industry at that time and he addressed the Western Gas Association in 1906 on the subject of "The Mutual Advantages to be Derived Through Cooperation Between Engineering Schools and Those Engaged in the Gas Industry."[76] In this paper he described the cooperative methods instituted particularly at the University of Wisconsin. It is also interesting to note that, when talking to the practical men to whom this paper was directed he defended "scientific" research as compared to that having a marked utilitarian value by stating:

> On the other hand, science for science's sake, is a motto, from the wearing of which no attempt at discouragement should be made, for many of the great blessings which come to mankind through discovery have resulted from the indefatigable labors of those men who have worked to increase the sum total of human knowledge and without the hope of immediate practical utility of such knowledge.

Burgess became a member of the Society for the Promotion of Engineering Education early in his teaching career (1896) and both he and Professor Dugald Jackson took an active part in its proceedings. In 1901 Burgess delivered a thought-provoking paper on "A Neglected Opportunity in Technical Education"[69] which precipitated a lively discussion. The gist of the paper is contained in the following excerpt:

> Although it is one of the purposes of public libraries to supply literature best selected for the needs of readers, an examination of the lists of books of scientific and technical nature in most public libraries and especially the smaller ones, will show how poorly this purpose has been fulfilled as regards the needs of the youth, workmen, artisans and others who wish to make a study of engineering subjects.

He pointed out there was much literature but it had little value to such readers "and it is in the seperation of the good from the bad that most librarians fail in choosing their technical books."

It is to be noted that he was not interested as much in the technically trained man as in the ambitious artisan without formal technical education who wanted to improve his lot. The Society thereupon appointed a Committee, of which Burgess was chairman, to advise libraries about the suitability of scientific text books (Chapter 16). The Society, as a result of the work of this Committee, issued a catalog of scientific books suitable for purchase by libraries.[70] Throughout his life he maintained an interest in books of the type which brought science to the technically-untrained person.

Apparently Burgess, for the same reason that he was interested in scientific books for artisans, was deeply interested in the work of correspondence schools. These schools aided the ambitious person who could not afford to devote all of his time to the acquiring of an education and it was this type of person that he was especially interested in and whom he wished to help. He was partial to their employment in his Laboratories. When, several years later (December 1912), the American School of Correspondence asked him to prepare an "Instruction Paper in Applied Electrochemistry" he cheerfully complied at a time when he was busy and deeply involved in University and business matters. The "Instruction Paper" was published as an 83-page text book by the

School.[71] In 1914 a section on electric welding by G. W. Cravens was added by the publishers to the book which was then entitled *Home Study Book on Applied Electrochemistry and Welding.* He was never too busy to assist those who helped themselves. This was the only "book" that he wrote although he had made plans to write and had started to write a number of them.

For a number of years Burgess continued to advise the American School of Correspondence about the teaching of chemistry and related fields. He gave that school every encouragement to go on with its work. In a letter dated October 4, 1916 he advised them that they would not get the enthusiastic support from most teachers of chemistry because of the latters' "hidebound characteristic" which made them "believe that it is impossible for a man to get a chemical training without getting it at an institution of higher learning." Futhermore, "In my opinion it is entirely feasible for men to get a fundamental knowledge of chemistry outside of the universities and I believe a list of books such as you propose would have a ready and extensive sale." Late in 1926 he became a member of the Advisory Board of the American School of Correspondence, the duties of that Board being "to receive and criticize occasionally instruction material."

Burgess never was impressed with vocational school training as a result of his experiences with it, which were limited largely to Madison, Wisconsin. He particularly criticized the erection of a costly vocational school building on valuable real estate, maintaining that "shop work should be taught in an industrial-type building," at a substantial saving to the taxpayer. Because of his keen interest in education he was asked to address the Wisconsin State Board of Industrial Education in July 1916 on "The Employer's Interest in Industrial Education" (apparently unpublished).

Burgess never lost his interest in the problems of education. Because of his strong belief in the handicraft approach to education he never was too busy to assist those who practiced this method of teaching. For example, when C. W. Wooden, an instructor in the Electrical Department in a Rochester, New York, high school, wrote to Burgess Battery Company in 1934 for materials to be used by the boys in his classes to make useful dry cells, Burgess soon learned of this and personally supervised the supplying of the necessary materials. He also carried on considerable correspondence over a period of years with Wooden in the course of which he wrote on June 16, 1934: "Having for eighteen years been engaged in educational work, the writer is thoroughly in sympathy with the kind of work which you are apparently doing, and also with the advantage it is to industrial concerns to keep in touch with educational matters"; and on July 2, 1934: "I fully agree with your method of instruction as tending to arouse the interest as well as giving useful information. If you wish to add to your list of problems, I will be glad to keep the matter in mind and give such suggestions as occur to me from time to time."

Industrial research was the basis of his Laboratories and Burgess was interested in educating the public, and business in particular, about

the benefits that could be derived from it. His views on this subject are given in two papers: "Industrial Chemical Research"[73] in 1911 and "Research Men from the Manufacturer's Viewpoint"[74] in 1916.

The part played by Burgess at the Louisiana-Purchase Exposition in St. Louis in 1904 is told in Chapter 12. Because such expositions are primarily educational a record is made here of his report made in 1905 to the American Electrochemical Society on electrochemistry in 1904 as represented at the exposition,[75] Burgess having been on the Jury of Awards that judged the electrochemical and electrometallurgical exhibits.

The engineering faculty of the University of Wisconsin cooperated with the Wisconsin Railroad and Tax Commissions. The faculty's work was described in a paper given before the Society for the Promotion of Engineering Education in 1910,[78] Burgess describing in Section C of the paper the cooperative work on gas and electric service which was under his direction.

Not only did Burgess teach others but he took advantage of every opportunity to be taught and to learn from others, as told in the biography. As late as 1915 he enrolled in a correspondence course in business (Chapter 20). He learned much from others, for he had an almost uncanny way of eliciting worthwhile information because of his keen questioning ability combined with a remarkable memory. When he was working on a difficult problem or one which had unusual aspects he would on occasion give a provocative or questioning talk about it to a group, if he thought that some of its members had knowledge of the subject. He hoped to profit by the discussion which would be sure to follow. To illustrate, the following quotation is taken from a talk which he gave on "Electrolysis as an Avocation" to the Chicago Section of The Electrochemical Society in about 1940 or 1941: "I am proceeding on the assumption that the sum total of knowledge which my audience possesses on the subject of my talk is greater than that which I possess and that, therefore, if I handle this meeting properly, I have an opportunity of adding to my knowledge." And that is what happened. At that time he was intensely interested in the controlled electrolytic solution of metals as described later in his Electrolick[55] pamphlet and it was the underlying subject of his talk though he was not yet ready to discuss his specific accomplishments. He raised a number of questions, and, sure enough, in the later discussion period the audience tried to answer the questions and entered into an informative discussion of the subject.

Section XI

STANDARDS FOR GAS AND ELECTRIC SERVICE IN THE REGULATION OF PUBLIC UTILITIES

IN carrying out his duties as expert on light and heat on the engineering staff of the Wisconsin Railroad Commission (Chapter 14), Burgess did a considerable amount of experimental work at the University because of the pioneering nature of some of his duties. This pioneering involved not only technical experimental work but it included efforts to secure the cooperation of the previously unregulated utilities, that is, it involved human relationships. How well Burgess succeeded is told in Chapter 14.

Burgess was author of several papers that had to do with his work on the Railroad Commission. The first of these in 1909 tells of the standards for gas and electric service that had been set up in Wisconsin.[77]

In 1910 Burgess gave two papers on this subject, one being on the cooperation of the University of Wisconsin with the Railroad Commission in carrying on the latter's work.[78] The second was a joint paper with W. J. Huddle of the Commission given before the Illinois Gas Association on "The Calorific Value of Gas in Wisconsin."[79] In the discussion that followed the presentation of the latter paper a representative of a Wisconsin utility said "I want to say one thing in reference to the Commission; they have not passed any rules or regulations that we could not meet, and we think they have been very fair." Other representatives of Wisconsin utilities agreed with this statement; the work of the Commission on gas regulation was praised and stated to be a "good thing" and that it had benefited every plant in the state. No doubt such statements by utility representatives were at least partially responsible for Professor O. L. Kowalke crediting Burgess largely for the early success of utility regulation in Wisconsin (Chapter 14).

In 1909 the American Gas Institute appointed Burgess a member of a Calorimetry Committee to standardize the methods for determining the heating value of gas and to make a general study of the characteristics of gas calorimeters. The prior work done under Burgess for the Wisconsin Railroad Commission on gas-heating values had shown the necessity for this study. The extensive laboratory work of the Committee was done in two laboratories, one of which was Burgess's department at the University. The Committee made several reports, the final being in 1912.

The stray-current electrolysis situation was one that Burgess investigated following his appointment to the Railroad Commission because it was a troublesome one that was encountered by many of the utilities. This subject is discussed at length in the section on Corrosion.

Section XII

MISCELLANEOUS

IN this section are included the more important activities and publications of Burgess that do not properly belong in any of the previous technical sections. The reader is referred also to Chapters 35 and 36 for an account of a number of additional activities at his Florida island home.

Two papers by Burgess which have to do with the commercial side of chemical engineering were published in 1910 and 1923, the first being entitled "Some Chemical Engineering Problems."[89] In the second, "The Market for Chemical Ideas,"[90] he states that a chemist has a choice of three ways in which to obtain compensation for his services but he discusses at length only the method in which the chemist more or less independently tries to sell the results of his research efforts as Burgess had been doing for many years and was doing through his Laboratories. He points out that the chemist, if he is to progress financially, must be more than merely skilled in chemistry. He must study and learn business methods, he must become interested in business affairs, and he must learn how to acquaint the public with the products of his efforts, that is, he must advertise. He points out some of the pitfalls that are encountered and summarizes what had been accomplished to that date by his Laboratories, which was following such a program.

Burgess wrote the annual reviews of electrochemistry for the *American Year Book* in 1910 and 1911.[91]

The acoustic developments and business of the Burgess Laboratories and later the Burgess Battery Company were important to those companies, being second only to the battery business. The inception of the acoustic work and the story of its early development are told in Chapter 30, Although the acoustic business was important Burgess did not concern himself with acoustic technical details during the time that Burgess Laboratories and Battery Company were active in this field. He, nevertheless, contributed four patents on acoustic inventions to supplement the considerable number of patents granted to the acoustic experts of the Burgess companies. The first[145] of these patents covered a small portable device, which included an electric bell operated by a flashlight cell, for demonstrating simply and quickly that the perforated metal facing for sound-absorbing materials of the R. F. Norris U. S. Patent No. 1,726,500 did not decrease their absorption. It was used to advantage when the Norris construction was first marketed by the Laboratories because it had been the belief that a perforated sheet-

metal facing, especially where the perforations covered only a small area of the surface, cut down appreciably the sound absorption of the back-up material. The other three acoustic patents covered features of sound-absorbing constructions, the first[147] relating to a construction for supporting sound-absorbing panels; the second[148] to a method for punching holes into sheet-metal facings for sound-absorbers and simultaneously fastening the two together by means of the sheet metal tines turned in by the punching operation; and the third[153] to a sound-absorbing construction in which the absorber is crumpled metal foil.

Because Burgess suffered from hay fever he was much interested in room ventilation and air conditioning. He encouraged the doing of a considerable amount of development work in this field which resulted in the marketing for a time of an acoustically-quieted power-driven window ventilator by Burgess Battery Company (Chapter 32). This preceded the development of the ceiling-ventilation construction referred to in Chapter 33.

In attempting to increase the speed of the machining of the alloy Illium-G, made by the Burgess-Parr Company, Burgess tried to find a more effective coolant for the cutting tool than the usual water or oil solutions. He found a jet of liquid carbon dioxide so effective that the metal removal rate could be increased several-fold without requiring the use of special alloy tools capable of withstanding high temperatures. The carbon dioxide evaporated and left clean dry shavings.[97] Because his application for patent was rejected and because of the incidence of World War II he never followed up the considerable amount of experimental work which was done on this development.

Burgess became interested in the late 30's in the use of modulated infrared light waves as a communication means over short distances, particularly between airplanes and between airplanes and the ground. Radio was objectionable because it was difficult to prevent messages from being picked up by enemy monitors. On the other hand infra-red waves could be used either during the day or night and could be projected in a narrow beam to the desired target with little possibility that they would be picked up except by the intended target. He spent personally over $6,000 on the development of transmitters and receivers, much of the work being done by the Armour Research Foundation.[98] After the United States entered World War II the results of the investigation were turned over to the Army Air Forces who carried on the further development work at Wright Field. This system is now being used by the Navy for two-way ship-to-ship and ship-to-shore voice communication.

The interest of Burgess in the fluff produced from the spike of the common cattail, Typha Latifolia and Typha Angustifolia, together with a brief account of what was accomplished by him during World War II in replacing kapok, imports of which were stopped when the Japanese invaded Java, are told in Chapter 38. He studied intensely the properties of this fluff sold under the trade name of Typha, and many uses were suggested and obtained for it as related in that chapter. Burgess gave a complete account (unpublished) of the development of the

cattail project at the Ninth Annual Chemurgic Conference held in Chicago on March 25, 1943, Paper No. 218.[99] A short account of this development together with a description of the properties and uses of the fluff was published in 1945.[254] The Northern Regional Research Laboratory of Peoria, Illinois,[255] studied the oil produced from the cattail seeds, a by-product of the fluff operations. The development during World War II was an outgrowth of an earlier interest in the cattail which had begun more than ten years previously. At that time he had devised also a method for making interesting "pelts" from the cattail spike. The spike was first dipped into latex which, after coagulating, formed a cylindrical web in which were anchored the exposed tips of the radial fibers. The web was slit longitudinally and the spike opened up to produce a small, soft and fur-like pelt which was remarkably resistant to wear and weather (Chapter 36, 37 and 38).

Burgess's penchant for keeping a diary is often referred to in the biography. Furthermore, he insisted that all employees likewise keep comprehensive diaries for the reasons given in an article which he wrote in 1934,[51] pertinent excerpts of which are quoted in Chapter 20.

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300. David Misell (to American Electrical Novelty and Manufacturing Co.) U. S. Pats. 603,112, April 26, 1898 and 617,592, Jan. 10, 1899
301. J. A. Viljoen (to C. F. Burgess Laboratories, Inc.) U. S. Pat. 1,911,411, May 30, 1933
302. Charles (sic) Weizmann, U. S. Pat. 1,315,585, Sept. 9, 1919
303. H. B. Speakman, J. Soc. Chem. Ind. 38, 155 (1919) and Frank Nathan, J. Soc. Chem. Ind. 38, 271 (1919)
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307. J. W. Richards, Trans. Am. Electrochem. Soc. 1, 41 (1902)
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HONORS AND RECOGNITIONS

University of Wisconsin
Doctor of Science, 1926
Illinois Institute of Technology
Doctor of Engineering, 1944
The Electrochemical Society (American Electrochemical Society)
Honorary Member, 1932
Edward Goodrich Acheson Medal and Award, 1942
President 1907-08
Society of Chemical Industry
Perkin Medal, 1932
Western Society of Engineers
Octave Chanute Medal, 1911
Life Membership, 1940
American Electro-Platers' Society
Honorary Member, 1914
Eugene Field Society of the National Association of Authors and Journalists
Honorary Member, 1945
Honorary Advisory Committee on Dedication of the Technological Institute (Northwestern University), 1942
National Radio Chamber of Commerce
Vice-President, 1922
Executive Committee of Section Xa-Electrochemistry of 8th International Congress of Applied Chemistry, 1912
Vice-President

Committee on Production, Organization, Manufacture and Standardization of Naval Consulting Board of the U. S., 1916
Committee on Organization of the International Electrical Congress, San Francisco World's Fair Exposition, 1915
Chicago Defense Committee of Chicago Section of American Chemical Society, 1941
Member of International Jury of Awards—St. Louis Exposition, 1904
Field Museum of Natural History, (Associate Member, October 18, 1928)
Advisory Committee on Conservation and Waste, State (Wisconsin) Council of Defense 1917
Royal Institution of Great Britain, Member, 1929
see also Fraternity list

FRATERNITIES

Beta Theta Pi
Tau Beta Pi (Honorary Engineering) Charter member of Wisconsin Alpha Chapter, 1899
Phi Lambda Upsilon (Honorary Chemical)
Honorary member
Sigma Xi (Honorary Scientific)
Alpha Chi Sigma (Professional Chemical)

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